

Greenhouse Gas Emission Standards for Light-Duty Vehicles

Manufacturer Performance Report for the **2013** Model Year



EPA-420-R-15-008a March 2015

Aston Martin
Lotus
McLaren
Tesla
Fisker
Porsche
Toyota
Honda
Mazda
Ford
Subaru
General Motors
Mitsubishi
Nissan
Volkswagen
BMW
Chrysler
Volvo
Mercedes-Benz
Suzuki
Jaguar
Land Rover
Ferrari
Coda
Aston Martin
Lotus
McLaren
Tesla
Fisker
Porsche
Toyota
Honda
Mazda
Ford
Subaru
General Motors
Mitsubishi
Nissan
Volkswagen
BMW
Chrysler
Volvo
Mercedes-Benz
Suzuki
Jaguar
Land Rover

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for the **2013** Model Year

NOTICE:

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments.

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EXECUTIVE SUMMARY

Background

On May 7, 2010, the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) issued a joint Final Rule to establish the first phase of a National Program with new standards for 2012 to 2016 model year light-duty vehicles that reduce greenhouse gas (GHG) emissions and improve fuel economy. These standards apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles. Subsequently, on October 15, 2012, EPA and NHTSA issued standards for GHG emissions and fuel economy of light-duty vehicles for model years 2017–2025, building on the first phase of the joint National Program.

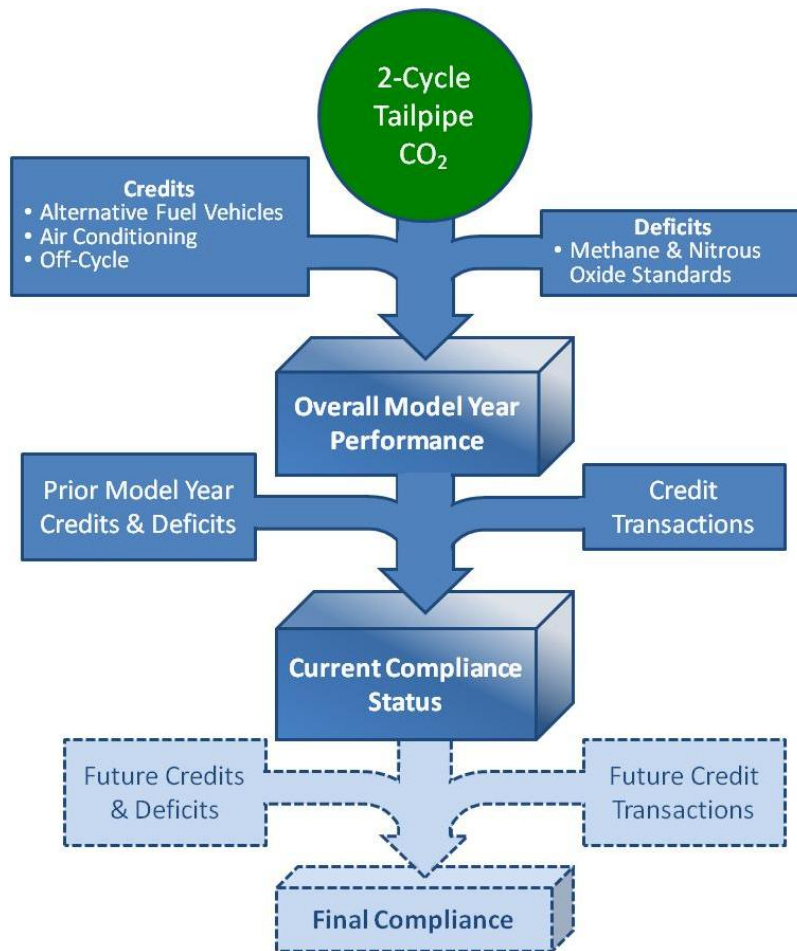
EPA is releasing this report as part of our continuing commitment to provide the public with transparent and timely information about manufacturers' compliance with the GHG program.¹ This report supersedes previous reports and details manufacturers' performance towards meeting GHG standards in the 2013 model year, the second year of the increasingly stringent GHG standards for model years 2012-2025. This report is also a reference for users of the GHG credits data, which we are making available in formats appropriate for importing into spreadsheets or database applications.²

The following figure illustrates the process and the inputs that determine a manufacturer's compliance with the light-duty vehicle GHG emission standards. Every manufacturer starts at the same place: by measuring the CO₂ tailpipe emissions performance of their vehicles using EPA's City and Highway test procedures (referred to as the "2-cycle" tests). Then they may choose to apply a variety of optional technology-based credits to further reduce their fleet GHG emissions compliance value. Today, the largest quantities of credits generated by manufacturers are for alternative fuel vehicles (primarily flexible fuel vehicles capable of operating on gasoline and E85) and for GHG reductions resulting from improved air conditioning systems that reduce refrigerant leakage and/or improve system efficiency. The 2-cycle tailpipe CO₂ value, when reduced by the net grams/mile equivalent of the optional credits, determines a manufacturer's model year performance and whether credits or deficits are generated by a manufacturer's model year fleet.

¹ Relevant information on the CAFE program can be found on the NHTSA website: <http://www.nhtsa.gov/fuel-economy>.

² This report and the data upon which it is based can be found and downloaded at <http://www.epa.gov/otaq/regs/ld-hwy/greenhouse/ld-ghg.htm>.

Process for Determining a Manufacturer's Compliance Status

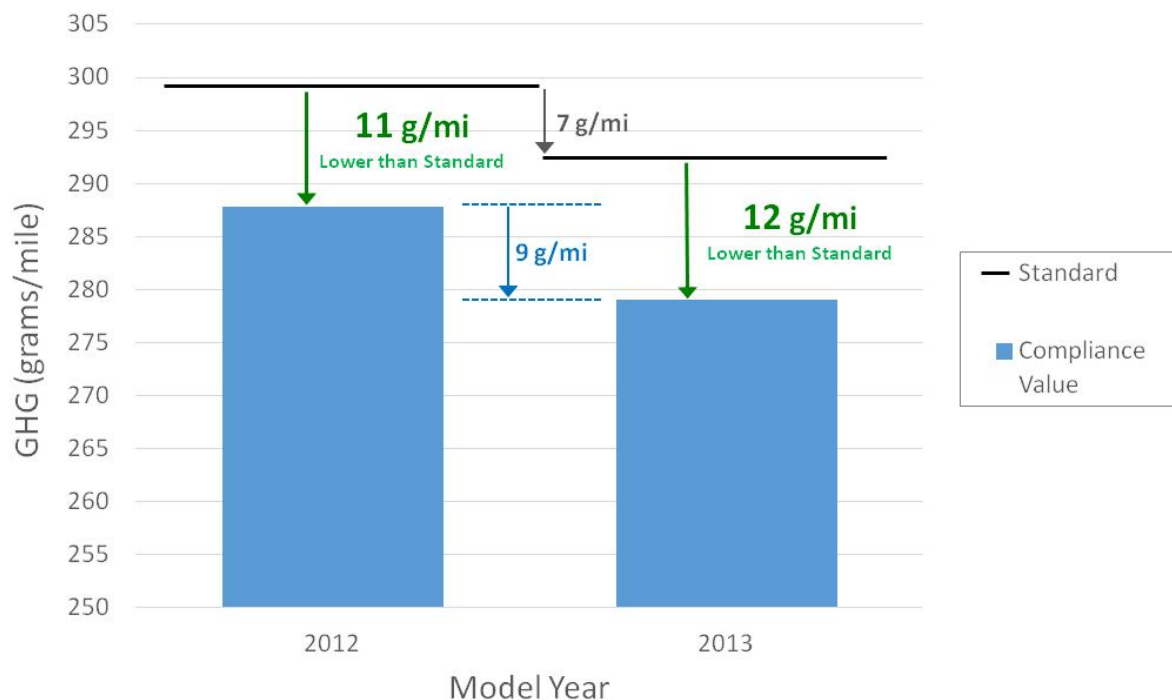


Individual model year performance, however, does not directly determine model year compliance or non-compliance. Manufacturers with deficits in a model year may use credits carried over from a previous model year to offset the deficit. They may also purchase credits from another manufacturer. Manufacturers with a deficit at the conclusion of a model year may also carry that deficit forward into the next model year. Manufacturers must, however, offset any deficit within three years after the model year in which it was generated. After considering these additional credits and deficits, EPA determines a manufacturer's current compliance status. For the 2012 and 2013 model years, there are two ways to describe a manufacturer's compliance status: (1) they have demonstrated compliance, or (2) they have not yet demonstrated compliance. No manufacturer is yet out of compliance with the GHG program in the 2012 or 2013 model years; their actions in subsequent years will ultimately determine final compliance.

1 *For the second consecutive year, the auto industry outperformed the GHG standard by a substantial margin*

Overall industry compliance in model year 2013 was 12 grams/mile better than required by the 2013 GHG emissions standard. This marks the second consecutive model year of industry outperforming the standards by a wide margin; industry compliance in 2012 was 11 grams/mile better than required. This industry-wide performance means that consumers bought vehicles with lower GHG emissions than required by the EPA 2013 GHG standards. See Section 3 for more detail on these values.³ Manufacturers continued this level of performance against increasingly stringent standards. While the industry-wide GHG standard decreased by 7 grams/mile from 2012 to 2013, manufacturers outpaced this increase in stringency by reducing compliance values by 9 grams/mile in 2013.

Industry Compliance Values versus Standards in 2012 and 2013 Model Years

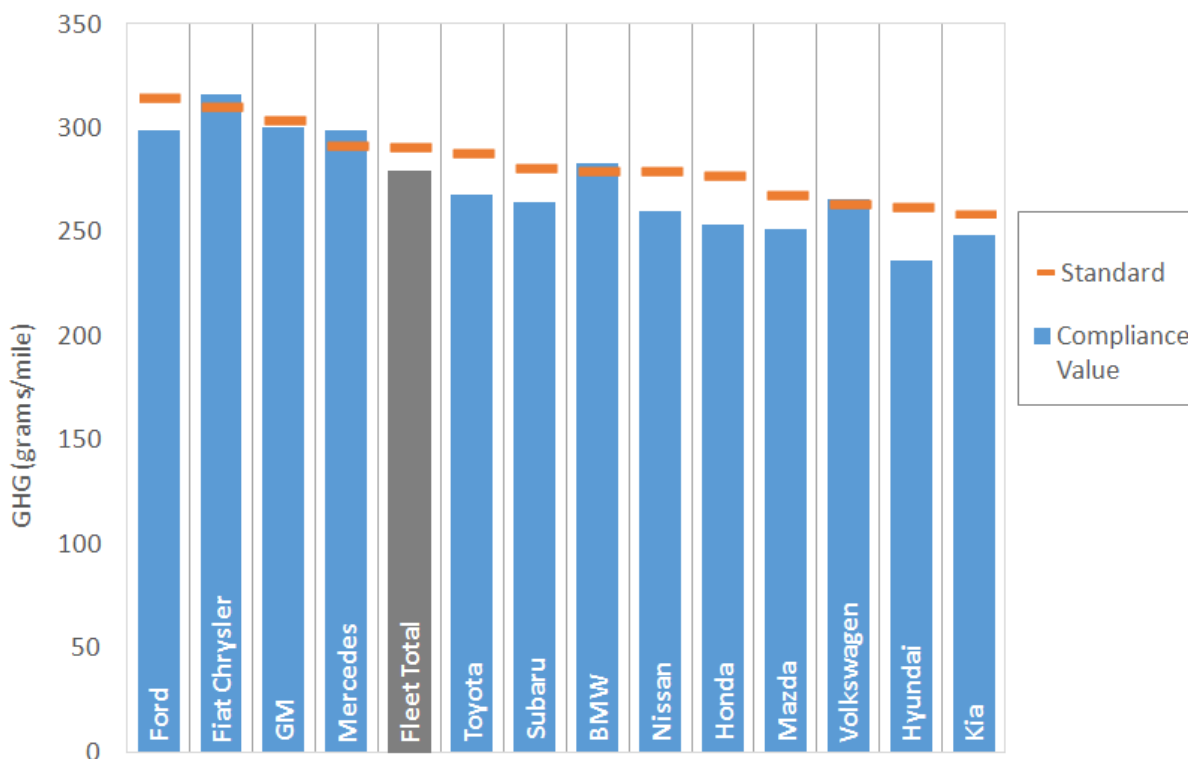


³ Note that although rounding of the values on the chart may produce some apparent inconsistencies, the numbers reported are correct.

2 *Most manufacturers outperformed their individual 2013 standard*

Most large manufacturers achieved fleet GHG compliance values lower than required by their unique 2013 standard and thus generated credits in the 2013 model year. Nine of the 13 manufacturers with sales greater than 100,000 vehicles beat their standard, with margins of compliance ranging from 27 grams/mile (Hyundai) to 4 grams/mile (GM). The remaining four manufacturers missed their unique 2013 standard by amounts ranging from 1 to 6 grams/mile, thus generating deficits, but in all cases these companies shrank their deficit relative to the 2012 model year. More detail about model year 2013 performance is provided in Section 3. The figure below does not include the impact of credit transfers (within a company) from prior model years or credit trades (transactions between companies), and thus does not portray whether or not a manufacturer has complied with 2012 or 2013 model year standards. The four manufacturers shown that did not outperform their 2013 standard – Fiat Chrysler, Mercedes, BMW, and Volkswagen – in fact had sufficient credits available from prior model years and thus complied with the 2012 and 2013 standards.

Manufacturer Compliance Values and Standards in the 2013 Model Year
(from highest to lowest GHG standard)



3 *All large manufacturers are in compliance with the 2012 and 2013 GHG standards*

The majority of manufacturers, representing more than 99 percent of U.S. sales, are in compliance with the standards for both the 2012 and 2013 model years. In fact, 21 of 26 manufacturers are carrying a positive credit balance into the 2014 model year, meaning that they have met both the 2012 and 2013 standards (credits cannot be carried forward if a deficit exists in a prior model year). The manufacturers currently with deficits in the 2012 and/or 2013 model year are allowed to carry those deficits forward for three model years, giving them time to generate or purchase credits to demonstrate compliance with the 2012 and/or 2013 model year standards. The current status of these manufacturers is neither compliance nor non-compliance – rather, they have not yet demonstrated compliance. The makeup of these credit and deficit balances is tracked by model year “vintage” as explained in Section 5. The credit balances shown below include “early credits” from model year 2009 that may not be sold and may not be used after the 2014 model year.

Credit Balances at Conclusion of the 2013 Model Year (Mg)⁴ **(including credit transfers & trades)**

| Manufacturer | Credits Carried to Model Year 2014 | | Manufacturer | Credits Carried to Model Year 2014 |
|--------------------------|---|--|---------------------|---|
| Toyota | 103,484,295 | | BMW | 456,812 |
| Honda | 50,234,560 | | Porsche | 426,439 |
| GM | 29,185,540 | | Volvo | 268,157 |
| Ford | 28,546,438 | | Mercedes | 129,312 |
| Hyundai | 23,186,604 | | Fisker | 46,694 |
| Nissan | 21,641,784 | | Coda | 7,251 |
| Kia | 13,016,497 | | BYD Motors | 2,276 |
| Subaru | 7,597,337 | | Tesla | 1,271 |
| Fiat Chrysler | 7,279,810 | | Ferrari | (653) |
| Mazda | 7,003,960 | | Lotus | (763) |
| Volkswagen | 5,789,961 | | McLaren | (3,620) |
| Mitsubishi | 1,565,382 | | Aston Martin | (4,783) |
| Suzuki | 693,553 | | Jaguar Land Rover | (927,143) |
| All Manufacturers | | | | 299,626,971 |

⁴ The Megagram (Mg) is a unit of mass equal to 1000 kilograms. It is also referred to as the metric ton or tonne.

4

Manufacturers continue to reduce GHG emissions while using a wide variety of compliance flexibilities that were designed into the program

EPA designed the standards with a wide range of flexibilities to allow manufacturers to maintain consumer choice, spur technology innovation, and minimize compliance costs, all while achieving significant GHG reductions. The flexibilities built into the program include standards based on vehicle size (or “footprint”), emissions averaging within car and truck fleets, credit trading between car and truck fleets, optional programs to generate credits, and processes to bank and/or trade credits. The result is that manufacturers can meet the standards while meeting consumer demand for a wide variety of vehicles, from high-performance vehicles to fuel-efficient hybrids, and from full-size pickups to small cars. In addition, the optional credit programs are facilitating the development and introduction of new technology. GM and Honda, for example, introduced a new and significantly less harmful air conditioning refrigerant to the U.S. automotive market in 2013 which lowered GHG emissions and helped them meet the GHG standards. Credit exchanges within and between companies also provide more flexibility in the program. Sections 2 through 4 provide more details on the use of the credits and flexibilities by each manufacturer.

Use of Compliance Program Flexibilities by Manufacturers in 2013 Model Year

| | | BMW | Fiat | Chrysler | Ford | GM | Honda | Hyundai | Kia | Mazda | Mercedes | Nissan | Subaru | Toyota | Volkswagen | Others |
|---------------------------|--|-----|------|----------|------|----|-------|---------|-----|-------|----------|--------|--------|--------|------------|--------|
| Core Design Elements | Footprint Based Targets | | | | | | | | | | | | | | | |
| | Car and Truck Standards | | | | | | | | | | | | | | | |
| | Fleet Averaging | | | | | | | | | | | | | | | |
| Generating Credits | Banked Early Credits | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| | Air Conditioning | X | X | X | X | X | X | X | | X | X | | X | X | X | X |
| | Off-Cycle | | | | X | | | | | | | | | | | |
| | Advanced Technology | | | X | X | X | | | | X | X | | X | | | X |
| | Flex Fuel Vehicles | | X | X | X | | | | | X | X | | X | X | | |
| | CNG Vehicles | | | | | X | | | | | | | | | | |
| Credit Transfers & Trades | Using Banked Credits | X | X | | X | | X | | X | X | X | X | X | X | X | X |
| | Carrying a Deficit to 2014 | | | | | | | | | | | | | | | X |
| | Trade: Credits Out | | | | | X | | | | | X | | | | | X |
| | Trade: Credits In | | X | | | | | | | X | | | | | | X |
| Other | Small Company Provisions | | | | | | | | | | | | | | | X |
| | CH ₄ & N ₂ O Alternative | X | X | X | X | | | | | | | | | X | | |

1. INTRODUCTION

A. Why are we releasing this information?

We are releasing this report as part of our continuing commitment to provide the public with transparent and timely information about manufacturers' performance under EPA's GHG program. In the two regulatory actions that established the GHG emissions standards for light-duty vehicles, EPA and NHTSA committed to making certain information public regarding the compliance of automobile manufacturers with the CO₂ and fuel economy standards.⁵ This report is the third such report released regarding EPA's GHG program. Previously, in March of 2013 we released a report documenting manufacturers' use of the early credit provisions allowed under the light-duty vehicle GHG program.⁶ In April of 2014 we released a report documenting the GHG performance of manufacturers in the 2012 model year, the first year that GHG standards were effective for all manufacturers.⁷ Because of changes that propagate back to prior model years, such as the credit transactions between manufacturers, this report supersedes previous reports and should not be compared to past reports.

When EPA and NHTSA issued the proposed rule for the 2012-2016 model year CO₂ and fuel economy standards, the proposal received considerable comment about the need for transparency regarding implementation of the program, and specifically, regarding compliance determinations.⁸ Many comments emphasized the importance of making GHG compliance information publicly available to ensure such transparency. This was also the case with the proposal for 2017-2025 model year GHG standards, in which we reiterated our commitment to the principle of transparency and to disseminating as much information as we are reasonably, practically, and legally able to provide.⁹ In response to the comments on the proposed rule for 2012-2016 model year standards we noted that our public release of data could include "...GHG performance and compliance trends information, such as annual status of credit balances or debits, use of various credit programs, attained fleet average emission levels compared with standards, and final compliance status for a model year after credit reconciliation occurs" and that we would "...reassess data release needs and opportunities once the program is underway."¹⁰

⁵ A comprehensive description of the EPA GHG program is beyond the scope of this document, thus readers should consult the regulatory announcements and associated technical documents for a detailed description of the program. See <http://www.epa.gov/otaq/climate/regs-light-duty.htm>.

⁶ Greenhouse Gas Emission Standards for Light-Duty Automobiles: Status of Early Credit Program for Model Years 2009-2011, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-13-005, March 2013.

⁷ Greenhouse Gas Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2012 Model Year, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-14-011, April 2014.

⁸ Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Proposed Rule, Federal Register 74 (28 September 2009): 49454-49789.

⁹ 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 77 (15 October 2012): 62889.

¹⁰ Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 75 (7 May 2010): 25469.

In the final rule for model years 2017-2025, we also committed to expanding the information we release regarding GHG program compliance, noting in the preamble that “...EPA intends to publish the applicable fleet average standards (for cars and for trucks) and the actual fleet performance for each manufacturer, and the resulting credits or debits.” Further, we stated that we anticipate publishing “...the amount of credits generated by each manufacturer (separately for each of the car and truck fleets) under the optional credit programs, and the associated volumes of vehicles to which those credits apply.” We also suggested that we would likely publish credit transactions, as well as the overall credit or debit balance for each manufacturer after taking into account the credit and debit carry-forward provisions and any credit transactions.

In addition to this and prior reports, we continue to release a considerable amount of information regarding fuel economy, emissions, and vehicle characteristics for each vehicle model. For example, starting with the 2013 model year, the downloadable data available at fuelconomy.gov includes CO₂ emission values for each vehicle model. In addition, we release actual vehicle emission test results at epa.gov/otaq/tcldata.htm. Finally, detailed information on long-term industry-wide CO₂, fuel economy, and technology trends since model year 1975 are at epa.gov/otaq/fetrends.htm. This latter report does not contain formal compliance data, but rather focuses on EPA’s best estimates of real world CO₂ emissions and fuel economy.

B. What data are we publishing?

The EPA GHG program requires compliance with progressively more stringent GHG standards for the 2012 through 2025 model years. The program includes certain flexibilities, several of which were designed to provide sufficient lead time for manufacturers to make technological improvements and to reduce the overall cost of the program, without compromising overall environmental objectives. The 2013 model year is the second year manufacturers have been subject to the standards, and thus it is the first year in which performance measures can be compared across model years (in this case, 2012 and 2013). This report makes such comparisons where appropriate. This report supersedes previous reports regarding manufacturer compliance with EPA’s GHG program.

The manufacturer-reported data which form the basis for this report was required to be submitted to EPA by the end of March of 2014.¹¹ The data reported by each manufacturer includes the calculated manufacturer-specific footprint-based CO₂ standard for each vehicle category (car and truck), the actual fleet-average tailpipe performance for each vehicle category (which includes flexible-fuel vehicle credits and credits for other alternative fuels such as compressed natural gas and electricity), the quantity of optional credits (e.g., based on air conditioning or off-cycle technology improvements), credit transfers within a manufacturer between car and truck fleets, credit trades between manufacturers, if applicable, and all the data necessary to calculate these reported values.

This report first updates and summarizes the credits generated under the early credit provisions, and then summarizes the data reported by manufacturers for the 2012 and 2013 model years in a

¹¹ See 40 CFR 600.512-12.

variety of ways. This includes separately detailing manufacturers' use of the flexibilities included in the program (e.g., credits for air conditioning improvements or production of flexible-fuel vehicles), as well as the credit transactions between manufacturers. This report also includes data from Hyundai and Kia for the first time in an EPA GHG report, as discussed in Section 1.D.4. The data presented in previous EPA reports has changed due to a number of factors described in this report, including the addition of Hyundai and Kia, and should no longer be considered current. For example, the inclusion of Hyundai and Kia data in the updated data increases the previously reported 2012 model year over-compliance of 10 grams/mile to 11 grams/mile. Values presented in this report are updated to reflect the new data, and previously-reported values for the 2009-2012 model years should be considered obsolete.

Vehicle and fleet average compliance for EPA's GHG program is based on a combination of CO₂, hydrocarbons, and carbon-monoxide emissions (i.e., the carbon-containing exhaust constituents). This is consistent with the carbon balance methodology used to determine fuel consumption for the vehicle labeling and CAFE programs. The regulations account for these total carbon emissions appropriately and refer to the sum of these emissions as the "carbon-related exhaust emissions," or "CREE." The carbon-containing emissions are combined on a CO₂-equivalent basis to determine the CREE value, i.e., adjusting for the relative carbon weight fraction of the specific emission constituent. Although the regulatory text uses the more accurate term "CREE" to represent the CO₂-equivalent sum of carbon emissions, the term CO₂ is used as shorthand throughout this report as a more familiar term for most readers.

The CO₂ standards in EPA's GHG program and the related compliance values in this report differ from the CO₂ values reported in EPA's "Trends" report or on new vehicle fuel economy labels.¹² The Trends report presents CO₂ and fuel economy values that are based on EPA's label methodology, which is designed to provide EPA's best estimate of the fuel economy and GHG emissions that an average driver will achieve in actual real-world driving. EPA's CO₂ standards, like the CAFE standards, are not adjusted to reflect real world driving. Instead, the GHG standards and compliance values are based on the results achieved on EPA's city and highway tests, weighted 55 and 45 percent, respectively. Results from these two tests are commonly referred to as the "2-cycle" test procedures, in that they are based on weighted results from two unique driving cycles. The CO₂ values that appear in the Trends report and on the EPA fuel economy window stickers will be about 25 percent higher than those in this report, and are based on what is frequently referred to as the "5-cycle" methodology, because the results are based on five different test procedures. The 5-cycle methodology includes tests that capture the impacts of aggressive driving, cold temperatures, and hot temperatures with air conditioning operating, among other factors. None of these factors are reflected in the 2-cycle tests used to determine compliance with CAFE and GHG standards.

¹² "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2014," U.S. EPA-420-R-14-023, Office of Transportation and Air Quality, October 2014. See <http://epa.gov/otaq/fetrends.htm>.

Credits are expressed throughout this report in units of Megagrams (Mg), which is how credits are reported to EPA by the manufacturers.¹³ Further, compliance is ultimately determined based on the balance of Megagrams of credits and/or deficits for a given model year, after accounting for credit transfers and trades. However, in order to present the impact of these credits in terms that might be more understandable, we calculate and present a grams per mile equivalent value where possible (see inset on this page for the methodology used to convert Megagrams to grams/mile). Where such a value in a table applies to a specific manufacturer, the grams per mile value represents the impact of credits on the fleet of that specific manufacturer, whereas the final Fleet Total row displays the grams per mile impact of the total credits across the entire 2012 or 2013 model year fleet of cars, trucks, or combined fleet, whichever may be applicable. Finally, this report does not attempt to summarize or explain all of the elements or details of EPA's GHG program. Readers should consult EPA's final regulations and supporting documents for additional information.¹⁴

How We Determine a Grams/Mile Equivalent from Megagrams (Metric Tons) of Credits and Deficits

The Megagrams (Mg) of credits or deficits reported to EPA are determined from values expressed in grams/mile. For example, fleet average credits/deficits are based on the difference between the fleet standard and the fleet average performance, each of which is expressed in grams/mile. The general form of the equation is:

$$\text{Credits[Mg]} = (\text{CO}_2 \times \text{VMT} \times \text{Production}) / 1,000,000$$

"CO₂" represents the credits in grams per mile. "VMT" represents the total lifetime miles, which we specified in the regulations as 195,264 miles for cars and 225,865 for trucks. "Production" represents the production volume to which the CO₂ credit applies.

The CO₂-equivalent of a credit value expressed in Mg is derived by reversing the equation as follows:

$$\text{CO}_2[\text{grams/mile}] = (\text{Credits[Mg]} \times 1,000,000) / (\text{VMT} \times \text{Production})$$

When using this equation to calculate CO₂ grams/mile for aggregate car and truck credits, we use a weighted average of the car and truck VMT values. For example, for the entire 2013 model year fleet covered by this report, the weighted VMT is 206,253 miles. The weighting is by the proportion of cars or trucks relative to the total fleet. The weighting may be applied on a manufacturer-specific basis or across the entire fleet, depending on the data presented in each table. Unless specifically stated, this is always the source of combined car/truck fleet values in this report.

C. How can CO₂ emissions credits be used?

The ability to earn and bank credits, including early credits, is a fundamental aspect of the program's design, intended to give manufacturers flexibility in meeting the 2012-2016 model year standards, as well as to aid in the transition to the progressively more stringent standards in the 2017-2025 model years. Credits represent excess emission reductions that manufacturers

¹³ The Megagram (Mg) is a unit of mass equal to 1000 kilograms. It is also referred to as the metric ton or tonne.

¹⁴ All of the background documents for EPA's GHG regulations are available on EPA's website at <http://www.epa.gov/otaq/climate/regs-light-duty.htm>.

achieve beyond those required by regulation under EPA’s program. Credit banking, as well as emissions averaging and credit trading (collectively termed “Averaging, Banking, and Trading”, or “ABT”) have been an important part of many mobile source programs under the Clean Air Act. These programs help manufacturers in planning and implementing the orderly phase-in of emissions control technology in their production, consistent with their unique redesign schedules. These provisions are an integral part of the standard-setting itself, and not just an add-on to help reduce costs. In many cases, ABT programs address issues of cost or technical feasibility which might otherwise arise, allowing EPA to set a standard that is more stringent than could be achieved without the flexibility provided by ABT programs. We believe that the net effect of the ABT provisions allows additional flexibility, encourages earlier introduction of emission reduction technologies than might otherwise occur, and does so without reducing the overall effectiveness of the program.

Credits (or deficits) are calculated separately for cars and trucks. If a manufacturer has a net deficit in either the car or truck category, existing credits must be applied towards that deficit. Although a deficit may be carried forward up to three years, under no circumstances is a manufacturer allowed to carry forward a deficit if they have credits available with which to offset the deficit. If credits remain after addressing any deficits, those credits may be “banked” for use in a future year, or sold or otherwise traded to another manufacturer. Credits earned in the 2010 through 2016 model years may be carried forward and used through the 2021 model year. Credits from the 2009 model year and 2017 and later model years may only be carried forward for five years. Thus, any early credits from the 2009 model year still held by a manufacturer after the 2014 model year will expire and be forfeited. In addition, credits from the 2009 model year may only be used within a manufacturer’s fleet, and may not be traded to another manufacturer.¹⁵

D. Which manufacturers and vehicles are included in this report?

The vast majority of manufacturers producing cars and light trucks for U.S. sale are currently covered by EPA’s GHG program and are included in this report. Small businesses are exempted from the program, and there are other manufacturers included in this report with unique circumstances, as explained below. The report generally uses the common and recognizable names for manufacturers, rather than their formal corporate names; “GM” instead of “General Motors Corporation,” “Ford” instead of “Ford Motor Company,” Mercedes” instead of “Mercedes-Benz,” and so on.

1. Small Businesses

Small businesses are exempt from EPA’s GHG standards given that these businesses would face unique challenges in meeting the standards. However, the program allows small businesses to waive their exemption and voluntarily comply with the GHG standards. For example, a small manufacturer of electric vehicles could choose to comply if they were interested in generating GHG credits and potentially participating in the credit market. For the purpose of this exemption, a small business is defined using the criteria of the Small Business Administration (SBA). For

¹⁵ These restrictions for the 2009 model year were established based on concerns that such credits might provide a “windfall” since the California light truck standards from which early credits could be generated are less stringent than the comparable CAFE standards in effect for that model year.

vehicle manufacturers, SBA's definition of a small business is any firm with less than 1,000 employees. These businesses account for less than 0.1 percent of the total car and light truck sales in the U.S., thus this exemption has a negligible impact on overall GHG reductions.

2. Small Volume Manufacturers

Similar to small businesses, some very small volume manufacturers (i.e., manufacturers with limited product lines and production volumes that do not meet the SBA definition of a small business) would likely find the GHG standards to be extremely challenging and potentially infeasible. Given the unique feasibility issues faced by these manufacturers, EPA deferred establishing CO₂ standards for model years 2012-2016 for manufacturers with annual U.S. sales of less than 5,000 vehicles.¹⁶

To be eligible for deferment in each model year, a manufacturer must demonstrate a good faith effort to attempt to secure GHG credits to the extent credits are reasonably available from other manufacturers. Credits, if available, would be used to offset the difference between a company's baseline emissions and what their obligations would be under the GHG footprint-based standards. Three manufacturers – Aston Martin, Lotus, and McLaren – requested and received a conditional exemption for the 2012 model year. Because the 2012 model year was the first model year of the program, and because companies seeking conditional exemptions were required to submit their requests to EPA prior to the start of the 2012 model year, it is not surprising that a credit market had not yet developed, despite inquiries made by these three companies of manufacturers that were holding credits. The only manufacturers with any credits at the time were those with optional early credits, and most were likely awaiting the conclusion of the 2012 model year to better evaluate their ability to sell credits. Because of their conditionally exempt status for the 2012 model year, these three manufacturers were not included in EPA's report that covered that model year.¹⁷ Since then, however, it has become clear that some manufacturers are willing to sell credits, and we have seen a number of credit transactions take place, as described in Section 4 of this report. As a consequence, EPA expects small volume manufacturers may be able to purchase credits and use them to comply with the standards in the 2013 and later model years. No conditional exemptions were approved for the 2013 model year, thus the three companies noted above are included in this report and are expected to comply with the provisions of the program. They may make use of certain flexibilities the program provides for this category of manufacturers, including temporary relaxed standards and the ability to petition EPA for alternative standards.

3. Operationally Independent Manufacturers

Some manufacturers, even though they may be wholly or largely owned by another manufacturer, may consider themselves to be "operationally independent" from the company that owns them. EPA's GHG program contains provisions that allow these manufacturers to seek

¹⁶ The deferment applies only to the fleet average CO₂ standards; these manufacturers are required to meet the applicable nitrous oxide (N₂O) and methane (CH₄) emission standards.

¹⁷ Conditional exemptions are available only through the 2016 model year, after which manufacturers must comply with the GHG program standards or petition EPA for alternative manufacturer-specific GHG standards. The three manufacturers noted here have already submitted applications requesting alternative standards, and EPA is in the process of reviewing those applications.

separate and independent treatment under the GHG standards, rather than be considered as part of their parent company. Manufacturers wishing to obtain operationally independent status are required to submit very detailed information to EPA regarding their business structure, financial operations, manufacturing operations, and management structure. The information in an application for operationally independent status must also be verified by an independent third party qualified to make such evaluations. Ferrari, which was owned by Fiat Chrysler Automobiles (FCA) during the 2013 model year, petitioned EPA for operationally independent status, and EPA granted this status to Ferrari starting with the 2012 model year.¹⁸ As an operationally independent manufacturer with a low U.S. sales volume (1,902 cars in the 2013 model year), Ferrari has the same options as the three small volume manufacturers discussed above. Ferrari was successful in acquiring a sufficient volume of credits from other manufacturers to entirely offset their 2012 model year deficit, as described Section 4, and, as seen in this report, the acquired credits also allowed them to substantially address their 2013 model year deficit.

4. Hyundai and Kia

Because of an ongoing investigation into Hyundai and Kia testing methods, their GHG performance was excluded from EPA's previous GHG reports. Although fuel economy label values were addressed with downward adjustments, the complete impact on their GHG values was unknown and potentially dependent on the results of the investigation. The investigation concluded with the announcement of a settlement on November 3, 2014. Hyundai and Kia will pay a \$100 million civil penalty to resolve alleged Clean Air Act violations based on their sale of more than 1 million vehicles that collectively will emit approximately 4.75 million metric tons of greenhouse gases in excess of what the automakers originally certified to the EPA. The companies will forfeit GHG emission credits in order to be at the same compliance levels that would have resulted if GHG emissions had been accurately reported for these vehicles in the first place. The companies also will take measures to prevent future violations. On November 3, 2014, the EPA and the U.S. Department of Justice (DOJ) announced this settlement, and lodged a consent decree embodying the settlement in the United States District Court for the District of Columbia.¹⁹ The California Air Resources Board joined the United States as a co-plaintiff in this settlement.²⁰

With the impact of Hyundai and Kia testing issues on their GHG values now established, this report is now able to include data from these companies going back to the 2009 model year. The addition of these companies to the underlying data changes some of the fleet-wide results presented in EPA's 2012 Performance Report; thus we present recalculated 2012 model year results here so that appropriate comparisons can be made between 2012 and 2013 performance and credit values. For example, we previously reported that the total fleet-wide over-compliance

¹⁸ Fiat Chrysler Automobiles (FCA) announced in October 2014 the intention to spin off Ferrari into a separate, shareholder-owned company. At the time of writing this report, Fiat Chrysler Automobile executives were indicating an intention to complete the spin-off in 2015. For the purpose of this report, however, Ferrari was majority-owned by Fiat Chrysler Automobiles and held operationally independent status in the 2012 and 2013 model years.

¹⁹ See <http://www2.epa.gov/enforcement/consent-decree-and-complaint-hyundai-and-kia-motor>.

²⁰ See <http://www2.epa.gov/enforcement/hyundai-and-kia-clean-air-act-settlement>.

in the 2012 model year was about 10 grams/mile, but the addition of the Hyundai and Kia data changes this to a value of 11 grams/mile.

As described in the Consent Decree, which was entered by the United States District Court for the District of Columbia on January 9, 2015, the companies have revised the GHG performance values for more than one million vehicles and, based on these corrected values, revised their reporting to EPA to account for the lower GHG performance of the affected vehicles. Most of the 4.75 million metric tons that must be accounted for by the companies under the Consent Decree is accounted for by the direct revision of GHG performance values of the affected vehicles, yielding fewer credits generated in the affected model years than would otherwise have been generated. The revised performance values do not fully account for the 4.75 million metric tons, however, and the companies must forfeit additional credits to meet the terms of the Consent Decree. In other words, the impact of using revised GHG values for affected vehicles reduced their total credits relative to using uncorrected values by slightly less than 4.75 million Mg, meaning that the companies must be debited an additional amount to comply with the terms of the Consent Decree. As a result, Hyundai is forfeiting an additional 161,176 Megagrams and Kia is forfeiting an additional 123,956 Megagrams. Both reductions will be taken from the 2013 model year balance of each company, as reflected in the cumulative results shown in Section 5.

At the time of publishing this report, Hyundai and Kia had submitted revised GHG reports pursuant to the Consent Decree. The information from those revised reports appears in this EPA report. The EPA is in the process of confirming the revised data and any corrections, if any are necessary, will appear in a subsequent EPA report.

5. Aggregation of Manufacturers

We refer throughout this report to the names of manufacturers at the highest aggregated level, and it may not be readily apparent who owns whom and which brands, divisions, subsidiaries, or nameplates are included in the results of a given manufacturer. Table 1-1 shows how manufacturers are aggregated based on the ownership relationships and vehicle partnerships in the 2013 model year. Many other manufacturers are covered in the report, but their names and brands are self-explanatory and thus are not shown in Table 1-1.

Table 1-1. Aggregation of Manufacturers in the 2013 Model Year

| Manufacturer | Manufacturers and Brands Included |
|--------------------------|--|
| BMW | BMW, Mini, Rolls-Royce |
| Fiat Chrysler | Chrysler, Dodge, Fiat, Jeep, Maserati, Ram ²¹ |
| Ford | Ford, Lincoln |
| GM | Buick, Cadillac, Chevrolet, GMC |
| Honda | Acura, Honda |
| Mercedes | Maybach, Mercedes, Smart |
| Nissan | Infinity, Nissan |
| Toyota | Lexus, Scion, Toyota |
| Volkswagen ²² | Audi, Bentley, Bugatti, Lamborghini, Volkswagen |

²¹ As explained above, Ferrari was owned by Fiat Chrysler Automobiles in the 2013 model year. However, due to the approved operational independence status of Ferrari (see Section 1.D.3), Ferrari is treated as a separate manufacturer for the purposes of compliance with the GHG program and thus is shown as a separate entity in this report.

²² In 2009 Volkswagen acquired 49.9 percent of Porsche, and in 2012 purchased the remaining 51.1 percent, resulting in Volkswagen's full ownership of Porsche. EPA regulations allow for a reasonable transition period in the case of mergers such as this, requiring that Volkswagen AG (including Porsche) meet the GHG standards as a single entity "beginning with the model year that is numerically two years greater than the calendar year in which the merger/acquisitions(s) took place." This means that Porsche will be considered a separate entity under the GHG program for the 2012 and 2013 model years, and in 2014 will be considered part of Volkswagen AG and included in the Volkswagen fleet for compliance purposes.

2. OPTIONAL GHG CREDITS FROM 2009-2011 MODEL YEARS

One of the flexibilities in the GHG program is an optional program that allowed manufacturers with superior greenhouse gas emission reduction performance to generate credits in the 2009-2011 model years. Because this was an optional program, without any compliance implications in these early model years, only those manufacturers that achieved emissions performance beyond that required by existing California or CAFE standards chose to provide data; thus the data does not include information for all manufacturers.

Early credits were earned through tailpipe CO₂ reductions, improvements to air conditioning systems that reduce refrigerant leakage or improve system efficiency, off-cycle credits for the implementation of technologies that reduce CO₂ emissions over driving conditions not captured by the “2-cycle” test procedures, and introduction of advanced technology vehicles (i.e., electric, fuel cell, and plug-in hybrid electric vehicles). The optional early credits program allowed manufacturers to select from four pathways that provided opportunities for early credit generation through over-compliance with a fleet average CO₂ level specified by EPA in the regulations. Manufacturers wishing to earn early credits selected one of these four pathways, and the selected pathway was followed for the three model years of 2009-2011. Since EPA’s GHG standards did not begin until model year 2012, EPA established tailpipe CO₂ thresholds below which manufacturers were able to generate early fleet average credits. For two of the pathways, the tailpipe emission levels below which credits were available were equivalent to the GHG standards established by California prior to the adoption of the EPA GHG program. Two additional pathways included tailpipe CO₂ credits based on over-compliance with CO₂ levels equivalent to the CAFE standards in states that did not adopt the California GHG standards. In March of 2013, EPA released a report documenting manufacturers’ use of the early credit provisions allowed under the GHG program (the “early credits report”).²³

Table 2-1 summarizes the credits (or deficits) reported by manufacturers in each of the three model years for each participating manufacturer and shows the total net early credits for each manufacturer. The early credits program required that participating manufacturers determine credits for each of the three model years under their selected pathway, and that they carry forward their net credits from the three early years to apply to compliance with EPA’s GHG standards in the 2012 and later model years. Thus, even manufacturers with a deficit in one or more of the early model years, (i.e., their tailpipe CO₂ performance was worse than the applicable emissions threshold under the selected pathway) could benefit from the early credits program if their net credits over the three years was a positive value. Manufacturers not listed in Table 2-1 chose not to participate in the early credits program. Additionally, this table is intended to show the credits reported by manufacturers in these years and does not include the impacts of any credit banking or trading on credit balances. In particular, the sale of some early

²³ Greenhouse Gas Emission Standards for Light-Duty Automobiles: Status of Early Credit Program for Model Years 2009-2011, Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Report No. EPA-420-R-13-005, March 2013.

credits by some manufacturers (see Section 4), while not shown in Table 2-1, has affected the available credit balances of the manufacturers involved in such transactions, as has the use of early credits to offset future model year deficits. Table 2-2 shows the total early credits reported by each participating manufacturer, broken down by the type of credit reported. Note that the early credits program did not include credits for flexible-fuel vehicles, whereas these credits are permitted in the 2012 and 2013 model years.

In addition to the introduction of Hyundai and Kia in the updated data, there are two other factors that may have changed the results of some manufacturers relative to what has been reported previously by EPA. First, during the process of confirming credits with EPA, some manufacturers discovered minor errors, the correction of which will be reflected in the data presented in this report. Second, in the regulations establishing the 2017-2025 GHG standards, EPA updated the method for determining credits for air conditioning refrigerant leakage by referring to new and revised versions of Society of Automotive Engineers (SAE) technical procedures. These updated and more accurate procedures became retroactively applicable to the early credit model years, as well as all future model years.²⁴ Although not required to do so, some manufacturers chose to revisit their 2009-2011 air conditioning leakage credits and submit the additional data required to generate credits using the updated SAE and regulatory procedures. Manufacturers that chose to do so will show an increase in their early air conditioning leakage credits relative to the credits shown in prior EPA reports.

²⁴ Instead of using default values to describe the rate at which refrigerant permeates a given type of hose, the new procedures allow the use of actual permeation rates as determined by an established SAE testing and measurement methodology. Many hoses were out-performing the established default values, leading to lower real-world emission rates (and thus higher emission credits) than were projected by the original and now superseded methodology.

Table 2-1. Total Early Credits, by Manufacturer and Model Year (Mg)

| Manufacturer | 2009 | 2010 | 2011 | Total |
|---------------|-------------------|-------------------|-------------------|--------------------|
| Aston Martin | 1,547 | 676 | 1,109 | 3,332 |
| BMW | 445,683 | 308,490 | 250,119 | 1,004,292 |
| Fiat Chrysler | 5,926,979 | 4,833,763 | (1,650,535) | 9,110,207 |
| Ford | 8,358,440 | 7,416,966 | 300,482 | 16,075,888 |
| GM | 13,009,374 | 11,073,134 | 482,321 | 24,564,829 |
| Honda | 14,073,890 | 14,070,290 | 7,370,928 | 35,515,108 |
| Hyundai | 4,605,933 | 5,388,593 | 4,012,969 | 14,007,495 |
| Kia | 3,134,775 | 2,651,872 | 4,657,545 | 10,444,192 |
| Mazda | 1,405,721 | 3,201,708 | 875,213 | 5,482,642 |
| Mercedes | 96,467 | 124,120 | 157,685 | 378,272 |
| Mitsubishi | 625,166 | 521,776 | 302,394 | 1,449,336 |
| Nissan | 10,496,712 | 5,781,739 | 1,852,749 | 18,131,200 |
| Subaru | 1,620,769 | 2,225,296 | 1,909,106 | 5,755,171 |
| Suzuki | 448,408 | 329,382 | 98,860 | 876,650 |
| Tesla | 0 | 35,580 | 14,192 | 49,772 |
| Toyota | 31,325,738 | 34,457,797 | 14,651,963 | 80,435,498 |
| Volkswagen | 2,243,205 | 2,811,663 | 1,386,537 | 6,441,405 |
| Volvo | 204,460 | 359,436 | 176,462 | 740,358 |
| Total | 98,023,267 | 95,592,281 | 36,850,099 | 230,465,647 |

Table 2-2. Total Reported Early Credits, By Credit Category

| Credit Category | Credits (Mg) | Percent of Total |
|----------------------------|--------------------|------------------|
| Tailpipe CO ₂ * | 198,792,034 | 86% |
| A/C Leakage | 23,438,974 | 10% |
| A/C Efficiency | 8,229,007 | 4% |
| Off-Cycle | 5,632 | <0.01% |
| Total | 230,465,647 | 100% |

*Tailpipe CO₂ credits in the early credits program do not include credits from flexible fuel vehicles.

Early credits from advanced technology vehicles (electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles) may be included in Table 2-2, depending upon how the manufacturer chose to account for them. In these early credit years, manufacturers producing advanced technology vehicles had two options available to them. They could simply incorporate these vehicles into their fleet averaging in the relevant model year calculations using zero grams per mile to represent the operation using grid electricity (see the discussion of advanced technology vehicles in Section 3.C for more information regarding this incentive). Alternatively, the program allowed manufacturers to exclude them from their fleet average in the 2009-2011 model years and carry the vehicles forward into a future model year, where they must be used to offset a GHG deficit. Four manufacturers had qualifying vehicles in the 2009-2011 model years.

GM and Mercedes chose the latter approach, while Nissan and Tesla chose the former approach. Advanced technology vehicle credits are discussed in more detail in Section 3.C which also shows the production volumes of advanced technology vehicles for the 2009-2013 model years.

Again, previous EPA reports regarding EPA's GHG program should serve only as historical references that are superseded by later reports. Each report is based on the best available data at the time of publication. This report regarding the 2013 model year, and the accompanying data for the 2009-2013 model years, should be used as the references from which to determine credit balances and overall performance at the conclusion of the 2013 model year, and prior reports should generally be considered obsolete.

3. CREDITS REPORTED FROM THE 2012-2013 MODEL YEARS

The mandatory compliance calculations that manufacturers must perform are: (1) to determine credits or deficits based on manufacturer-specific, vehicle footprint-based CO₂ standards for both car and truck fleets, and (2) to demonstrate compliance with N₂O (nitrous oxide) and CH₄ (methane) exhaust emission standards. Compliance with CO₂ standards is assessed separately for car and truck fleets at the end of each model year, using emission standards and fleet average values determined based on the sales-weighted actual production volumes of the model year. Compliance with N₂O and CH₄ standards is typically done in conjunction with emission tests for other pollutants, although there are additional options as described later in this report.

Although the minimum requirement is that manufacturers calculate credits (or deficits) based on fleet average tailpipe CO₂ emissions, manufacturers have several options to generate additional credits as part of their overall strategy to reduce GHG emissions and meet the standards. These options are described in detail in this report, and include credits for gasoline-ethanol flexible fuel vehicles, improvements to air conditioning systems that increase efficiency and reduce refrigerant leakage, reductions in emissions that aren't captured on EPA tests ("off-cycle" emissions), transitional alternative standards (for eligible low-volume manufacturers), and advanced technology vehicle incentives. The use of the optional credit provisions varies from manufacturer to manufacturer (some manufacturers have not availed themselves of the extra credit options, while others have used some combination of, or all, options available under the regulations). Although a manufacturer's use of the credit programs is optional, EPA projected that the standards would be met on a fleet-wide basis by using a combination of reductions in tailpipe CO₂ and use of the additional optional credit and incentive provisions in the regulations.

Compliance with the EPA GHG program is achieved with the use of many different building blocks, starting with tailpipe emissions levels and, depending on need, strategy, and technology development and availability, employing one or more credit or incentive programs as additional elements contributing to compliance. Depending on the manufacturer, certain of these credit and incentive building blocks may or may not be used. However, all manufacturers start with the same two mandatory building blocks: (1) GHG emissions on a gram/mile basis as measured on EPA test procedures, and (2) fleet-specific grams/mile CO₂ standards based on the footprint of models produced in each car and truck fleet in a given model year. If a manufacturer uses no credits, incentive programs, or alternative standards (if applicable), then we can assess compliance by comparing the fleet average emissions from the emission tests with the fleet-specific footprint-based standards. However, most manufacturers are using some credits, incentives, or alternative standards (if applicable), thus for those manufacturers (and for the aggregated fleet as a whole) these building blocks must be accounted for before determining whether or not a standard is met. Indeed, EPA's rulemaking analysis projected that the use of credits and incentive programs was expected to be an integral part of achieving compliance, especially in the early years of the program.

We begin by discussing the “2-cycle” tailpipe GHG emissions value (Section 3.A), which is the starting point for compliance for every manufacturer. We then detail each of the different credit and incentive programs, distilling each to an overall grams/mile impact for each manufacturer. Section 3.B describes the temporary lead time allowance alternative standards (TLAAS); Section 3.C describes alternative fuel vehicle incentives, including the temporary flexible

fuel vehicle incentives; Section 3.D describes credits based on air conditioning system improvements; Section 3.E describes off-cycle emission reductions; and Section 3.F discusses the impact of alternative methane and nitrous oxide standards. Once these values have been determined, the 2-cycle tailpipe value is reduced by the total of all the credit and incentive programs to determine a “compliance value,” as described in Section 3.G. Section 3.H describes the derivation of manufacturer-specific CO₂ standards, which leads into Section 3.I which concludes Section 3 by comparing the compliance values to the CO₂ standards to determine whether or not a given fleet generates credits or deficits in the 2013 model year. We also show results aggregated on an industry-wide car and light truck fleet basis and an industry-wide total combined fleet basis for informational purposes.

IMPORTANT NOTE REGARDING TABLES

Many of tables in this section have a final row labeled “Fleet Total” This row indicates a value that is calculated based on the entire model year fleet and is not specific only to the manufacturers listed in the table. For example, not all manufacturers generated credits for air conditioning systems, but the final “Fleet Total” row in those tables indicates values that are calculated to show the impact of air conditioning credits on the entire model year fleet (i.e., across all manufacturers, whether or not they reported air conditioning credits).

This report approaches the description of manufacturer compliance somewhat differently than did the report for the 2012 model year. Instead of focusing on Megagrams of credits and deficits (which is how credits are reported to EPA by the manufacturers), this section of the report will describe compliance (for each manufacturer’s car, truck, and combined fleets, as well as for the aggregated industry) by describing each of the building blocks of compliance and the grams/mile contribution to a manufacturer’s total compliance. However, note that the grams/mile values are calculated only for the purpose of this report, and are not specific compliance values defined in the regulations.

A. “2-Cycle” Tailpipe CO₂ Emissions

The starting point for each manufacturer is to test their vehicles on two test procedures defined in EPA regulations: the Federal Test Procedure (known as the “City” test) and the Highway Fuel Economy Test (the “Highway” test). These tests produce the raw emissions data that is ultimately augmented by air conditioning credits, off-cycle credits, incentives for dual fuel vehicles, and other provisions to produce the total compliance picture for a manufacturer’s fleet. Results from these two tests are averaged together, weighting the City results by 55% and the Highway results by 45%, to achieve a single value for each vehicle model. A sales-weighted average of all of the combined city/highway tailpipe values is calculated for each passenger car and light truck fleet. This value represents the actual tailpipe CO₂ emissions of a fleet without the application of any additional credits or incentives, and as such, comparison with a fleet-specific CO₂ standard would be inappropriate.

Table 3-1 shows the 2-cycle tailpipe emissions for the car, truck and combined fleets for each manufacturer, for both the 2012 and 2013 model years.²⁵ Absent the use of credits and incentives, manufacturers demonstrated overall reductions in tailpipe GHG emissions in both the car and truck categories in 2013 relative to 2012. On both a grams/mile and percentage basis the most significant reductions from the 2012 to the 2013 model year came from Jaguar Land Rover and Nissan, both of which achieved reductions of almost 30 grams/mile in their fleet-wide tailpipe CO₂ emissions. Mercedes and Subaru followed behind with reductions of six percent, while most other manufacturers came in with more modest reductions of two to five percent. On the other hand, Ford, Toyota, and Volvo each experienced small increases in overall GHG emissions in 2013 relative to 2012. Ford, in particular, is an interesting case study that illustrates the interaction of different inputs and the influence on some of these values. From 2012 to 2013 Ford decreased the CO₂ emissions of their car and truck fleets by 5 and 10 grams/mile, respectively, yet on an overall combined fleet basis their emissions increased by 6 grams/mile (about two percent) in 2013. What lies behind the 6 grams/mile CO₂ overall emissions increase, when both cars and trucks showed reductions, is a shift in Ford's fleet from 40% trucks in the 2012 model year to 51% trucks in the 2013 model year (see Appendix B for car and truck production volume data). This shift, combined with the higher VMT of trucks (see inset in Section 1.B for a description of VMT values for cars and trucks), leads to Ford's overall increase in 2-cycle tailpipe emissions in the 2013 model year, despite showing an improvement in both car and truck categories. Note that this does not indicate anything in particular about Ford's overall compliance with the program, which is based upon an aggregation of all credits and deficits and not solely on the 2-cycle tailpipe emissions shown in Table 3-1. In fact, Ford continues to generate net credits in both their car and truck fleets and has fully complied with the standards in both 2012 and 2013 model years.

²⁵ The values in this table do not include the impacts of credits or incentives resulting from FFVs, CNG vehicles, air conditioning improvements, and off-cycle technologies. The impact of these is detailed in subsequent sections. The values also reflect that direct tailpipe GHG emissions from electricity are zero. Because the values in this table do not include these credits and incentives, the table does not describe a manufacturer's actual model year performance or a manufacturer's compliance position at the end of the 2013 model year.

Table 3-1. "2-cycle" Tailpipe CO₂ Production-Weighted Fleet Average Emissions (g/mi)

| Manufacturer | Model Year 2012 | | | Model Year 2013 | | | Change, 2012 to 2013 | | |
|-----------------------------|-----------------|------------|------------|-----------------|------------|------------|----------------------|-------------|------------|
| | Cars | Trucks | All | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin ^{A B} | | | | 444 | | 444 | | | |
| BMW | 277 | 363 | 302 | 271 | 346 | 292 | (6) | (17) | (10) |
| BYD Motors ^B | 0 | | 0 | 0 | | 0 | 0 | | 0 |
| Coda ^B | 0 | | 0 | 0 | | 0 | 0 | | 0 |
| Ferrari ^B | 494 | | 494 | 475 | | 475 | (19) | | (19) |
| Fiat Chrysler | 300 | 384 | 357 | 289 | 380 | 344 | (11) | (4) | (13) |
| Fisker ^{B C} | 146 | | 146 | | | | | | |
| Ford | 261 | 385 | 315 | 256 | 375 | 321 | (5) | (10) | 6 |
| GM | 283 | 397 | 331 | 273 | 395 | 325 | (10) | (2) | (6) |
| Honda | 237 | 320 | 266 | 228 | 312 | 257 | (9) | (8) | (9) |
| Hyundai | 243 | 312 | 249 | 238 | 317 | 241 | (5) | 5 | (8) |
| Jaguar Land Rover | 376 | 439 | 426 | 342 | 414 | 398 | (34) | (25) | (28) |
| Kia | 258 | 324 | 266 | 252 | 301 | 254 | (6) | (23) | (12) |
| Lotus ^{A B} | | | | 334 | | 334 | | | |
| Mazda | 241 | 324 | 263 | 232 | 296 | 251 | (9) | (28) | (12) |
| McLaren ^{A B} | | | | 374 | | 374 | | | |
| Mercedes | 316 | 393 | 343 | 296 | 371 | 321 | (20) | (22) | (22) |
| Mitsubishi | 262 | 283 | 267 | 254 | 267 | 258 | (8) | (16) | (9) |
| Nissan | 258 | 382 | 295 | 232 | 340 | 266 | (26) | (42) | (29) |
| Porsche | 325 | 362 | 342 | 309 | 363 | 336 | (16) | 1 | (6) |
| Subaru | 257 | 296 | 282 | 254 | 270 | 264 | (3) | (26) | (18) |
| Suzuki | 267 | 361 | 287 | 266 | 330 | 273 | (1) | (31) | (14) |
| Tesla ^B | 0 | | 0 | 0 | | 0 | 0 | | 0 |
| Toyota | 221 | 354 | 273 | 224 | 347 | 278 | 3 | (7) | 5 |
| Volkswagen | 274 | 330 | 281 | 272 | 327 | 279 | (2) | (3) | (2) |
| Volvo | 297 | 343 | 311 | 292 | 348 | 318 | (5) | 5 | 7 |
| Fleet Total | 259 | 369 | 302 | 251 | 360 | 294 | (8) | (10) | (8) |

^AExempt from compliance with 2012 model year standards. ^BOnly manufactures cars. ^CDid not produce any 2013 model year vehicles. This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

B. TLAAS Program Standards

EPA established the Temporary Lead-time Allowance Alternative Standards (TLAAS) to assist manufacturers with limited product lines that may be especially challenged in the early years of EPA's GHG program. The TLAAS program was established to provide additional lead-time for manufacturers with narrow product offerings which may not be able to take full advantage of averaging or other program flexibilities due to the limited scope of the types of vehicles they sell. In the 2012 model year the program was used by Ferrari, Jaguar Land Rover, Mercedes, and Porsche. Aston Martin, Lotus, and McLaren – companies that were exempt from the 2012

standards under the program's small volume manufacturer provisions – joined the program in the 2013 model year and incorporated use of the TLAAS standards in their 2013 model year compliance.

The TLAAS program applies only to manufacturers with 2009 model year U.S. sales of less than 400,000 vehicles, and, except as noted below, is available during the 2012-2015 model years. Under this program, a manufacturer is allowed to treat a portion of its fleet as a separate averaging fleet to which a less stringent CO₂ standard applies. Specifically, a qualifying manufacturer may place up to 100,000 vehicles (combined cars and trucks) under the less stringent standards over the four model years from 2012 through 2015 (i.e., this is a total allowance, not an annual allowance). The CO₂ standard applied to this limited fleet is 1.25 times – or 25 percent higher than – the standard that would otherwise be calculated for the fleet under the primary program. Manufacturers with 2009 model year U.S. sales of less than 50,000 vehicles are allowed an additional 150,000 vehicles (for a total of 250,000 vehicles at the 25 percent higher standard), and can extend the program through the 2016 model year (for a total eligibility of five model years).

All manufacturers participating in the TLAAS program are subject to a number of restrictions designed to ensure its use only those manufacturers that truly need it. Manufacturers using the TLAAS program may not sell credits, they may not bank credits that are accrued by their non-TLAAS fleets, they must use up any banked credits before utilizing a TLAAS fleet, and the movement of credits between a manufacturer's TLAAS and non-TLAAS fleets is restricted.

There are four possible fleets for emissions averaging and credit or deficit calculation under the TLAAS program: both cars and trucks in either the Primary or TLAAS program. Manufacturers employed a variety of strategies in the use of the TLAAS program in the 2012 and 2013 model years. The smallest-volume companies (Aston Martin, Ferrari, Lotus, and McLaren) placed all of their 2013 production into a TLAAS fleet, because they can do so without any risk of exceeding the applicable limits. Porsche, which has placed all of its 2012 and 2013 vehicles in the TLAAS program to date (totaling more than 70,000 vehicles), would reach the 100,000 vehicle limit in the 2014 model year except for the fact that they will be aggregated with the Volkswagen fleet in the 2014 model year and no longer eligible to use the TLAAS program.

Table 3-2 shows each manufacturer's use of the TLAAS program for the 2012 and 2013 model years. By virtue of their 2009 model year sales volume being lower than 50,000 vehicles, Jaguar Land Rover qualifies for the "extended" TLAAS program, and thus they have about 165,000 vehicles remaining to which they may apply the TLAAS standards through the 2016 model year. Mercedes is subject to the 100,000 vehicle allotment, and thus can distribute about 40,000 more vehicles into the TLAAS program across the 2014 and 2015 model years. Note that the total of 219,320 vehicles placed under the less stringent standards in the program to date represents less than one percent of the total vehicles produced in the 2012 and 2013 model years.

While required by the regulations, the complexity of reporting credits and deficits in Megagrams of CO₂ can sometimes obscure the progress that companies are actually making towards reducing their GHG emissions. The approach we have developed in this report provides the transparency needed to be able to make these evaluations. Mercedes and Jaguar Land Rover, the

largest of the manufacturers using these temporary and limited alternative standards, both made substantial progress reducing tailpipe GHG emissions from 2012 to 2013. As shown in the previous section, Jaguar Land Rover reduced their overall tailpipe emissions by 28 grams/mile, Mercedes reduced their emissions by 22 grams/mile, Ferrari reduced their tailpipe emissions by 19 grams/mile, and Porsche reduced their tailpipe GHG emissions by a more modest 6 grams/mile.

Table 3-2. Production Volumes Assigned To TLAAS Standards

| Manufacturer | Model Year 2012 | | | Model Year 2013 | | | Cumulative Total |
|--------------------|-----------------|---------------|----------------|-----------------|---------------|----------------|------------------|
| | Cars | Trucks | All | Cars | Trucks | All | |
| Aston Martin | | | | 364 | | 364 | 364 |
| Ferrari | 1,510 | | 1,510 | 1,902 | | 1,902 | 3,412 |
| Jaguar Land Rover | 12,769 | 32,706 | 45,475 | 9,410 | 29,464 | 38,874 | 84,349 |
| Lotus | | | | 170 | | 170 | 170 |
| McLaren | | | | 412 | | 412 | 412 |
| Mercedes | 10,585 | 20,230 | 30,815 | 6 | 28,437 | 28,443 | 59,258 |
| Porsche | 16,946 | 12,927 | 29,873 | 22,021 | 19,461 | 41,482 | 71,355 |
| Fleet Total | 41,810 | 65,863 | 107,673 | 34,285 | 77,362 | 111,647 | 219,320 |

To understand the impact of the TLAAS program on compliance with EPA’s GHG program, we determined the grams/mile “benefit” achieved by each manufacturer and accrued for each fleet as a result of using the TLAAS program. For manufacturers placing all their vehicles in a TLAAS fleet the calculation is easy; it is simply the difference between the TLAAS program standard and the Primary Program standard that would have otherwise applied. For manufacturers with a mix of TLAAS and Primary Program vehicles in each fleet, we determined the difference in the total credits (in Megagrams) for each fleet with the use of TLAAS and without the use of TLAAS. This difference was then converted to grams/mile, and the resulting values are shown in Table 3-3. The final row in the table indicates the overall impact from the use of the TLAAS program on the entirety of the 2012 and 2013 model year fleets, not just the set of manufacturers enrolled in the TLAAS program. Thus, the overall net impact on the 2013 fleet of the TLAAS program is 0.6 g/mi.

Table 3-3. Net Impact From Use Of The TLAAS Program (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|---------------------|------------------------|---------------|------------|------------------------|---------------|------------|
| | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 64 | | 64 |
| Ferrari | 69 | | 69 | 66 | | 66 |
| Jaguar Land Rover | 73 | 64 | 66 | 41 | 49 | 47 |
| Lotus | | | | 62 | | 62 |
| McLaren | | | | 66 | | 66 |
| Mercedes | 4 | 22 | 10 | 0 | 27 | 9 |
| Porsche | 66 | 84 | 75 | 63 | 82 | 73 |
| Fleet Total | 0.3 | 1.2 | 0.7 | 0.2 | 1.2 | 0.6 |

C. Credits Based On Alternative Fuel Vehicles

EPA's GHG program contains several credits and incentives for dedicated and dual fuel alternative fuel vehicles. Dedicated alternative fuel vehicles are vehicles that run exclusively on an alternative fuel (e.g., compressed natural gas, electricity). Dual fuel vehicles can run both on an alternative fuel and on a conventional fuel such as gasoline; the most common is the gasoline-ethanol flexible fuel vehicle, which is a dual fuel vehicle that can run on E85 (85 percent ethanol and 15 percent gasoline), or on conventional gasoline, or on a mixture of both E85 and gasoline in any proportion. Dual fuel vehicles also include vehicles that use compressed natural gas (CNG) and gasoline, or electricity and gasoline. This section separately describes three different and uniquely-treated categories of alternative fuel vehicles: advanced technology vehicles using electricity or hydrogen fuel cells; compressed natural gas vehicles; and gasoline-ethanol flexible fuel vehicles.

1. Advanced Technology Vehicles

EPA's GHG program contains incentives for advanced technology vehicles. Specifically, these incentives apply to electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles (and, starting with the 2017 model year, CNG vehicles). For the 2012-2016 model years, the incentive program allows electric vehicles and fuel cell vehicles to use a zero grams/mile compliance value, and plug-in hybrid electric vehicles may use zero grams/mile to represent the use of grid electricity (i.e., only emissions are "counted" from the gasoline engine operation). Use of the zero grams/mile option is limited to the first 200,000 qualified vehicles produced by a manufacturer in the 2012-2016 model years. Electric vehicles, fuel cell vehicles, and plug-in hybrid electric vehicles that were included in a manufacturer's calculations of early credits also count against the production limits. As noted in Section 2, both GM and Mercedes selected an option in the early credit provisions by which they set aside their 2011 model year advanced technology vehicles for inclusion in a future model year, meaning that the impact of these vehicles – albeit small – has yet to be seen in any model year.

All manufacturers of advanced technology vehicles in the 2012 and 2013 model years are well below the cumulative 200,000 vehicle limit for the 2012-2016 model years, thus all

manufacturers remain eligible to continue to use zero grams/mile. If a manufacturer were to reach the cumulative production limit before the 2017 model year, then advanced technology vehicles produced beyond the limit must account for the net “upstream” emissions associated with their vehicles’ use of grid electricity relative to vehicles powered by gasoline. Based on vehicle electricity consumption data (which includes vehicle charging losses) and assumptions regarding GHG emissions from today’s national average electricity generation and grid transmission losses, a midsize electric vehicle might have upstream GHG emissions of about 180 grams/mile, compared to the upstream GHG emissions of a typical midsize gasoline car of about 60 grams/mile. Thus, the electric vehicle would have a net upstream emissions value of about 120 grams/mile. EPA regulations provide all the information necessary to calculate a unique net upstream value for each electric or plug-in hybrid electric vehicle.²⁶

The nature of this incentive is such that it is reflected in the 2-cycle emissions values shown in Section 3.A. For example, the incentive allows Tesla to record zero grams/mile for their fleet (see Table 3-1) in the 2013 model year. Without the incentive, however, the 2-cycle fleet average GHG emissions for Tesla would in fact be about 122 grams/mile.²⁷ Use of the incentive in Tesla’s case allows them to generate an additional 425,000 Mg of GHG credits relative to using the net upstream value of 122 grams/mile. Nissan’s 2013 passenger car fleet benefits similarly from the ability of the electric Leaf to use zero grams/mile instead of the calculated net upstream value of 70 grams/mile.²⁸ As a result, the overall impact on Nissan’s passenger car fleet is an improvement of two grams/mile, allowing them to generate almost 360,000 Mg of credits more than if the incentive provisions were not in place. The net impact from Nissan and Tesla on the entire 2013 model year fleet of this incentive is thus almost 800,000 Mg of credits, or about 0.3 grams/mile. While there are other electric vehicles and plug-in hybrid electric vehicles in the 2013 fleet, as shown in Table 3-4, Nissan and Tesla account for almost half of the 2013 model year volume of these vehicles. A few thousand of the remaining vehicles are electric vehicles, but the majority are plug-in hybrid electric vehicles, which will have a smaller overall impact than electric vehicles because of their use of gasoline in addition to electricity (the other companies with larger volumes in this technology segment – GM and Ford – are selling far more plug-in hybrids than dedicated electric vehicles). Because it is unlikely that the total impact of this incentive exceeds 0.5 grams/mile across the 2013 model year fleet, we have not carried out the analysis for all advanced technology vehicles. Determining the net upstream values for plug-in hybrid electric vehicles is particularly cumbersome and will not add much to an already-minimal impact, thus we have avoided those analyses for this report. In the future, however, it may be more important, interesting, and useful to have a complete assessment of the impact of incentives for these vehicles. Table 3-4 shows the 2010-2013 production volumes of advanced technology vehicles that applied the zero gram/mile incentive.

²⁶ See 40 CFR 600.113-12, paragraph (n).

²⁷ Using the calculations prescribed in the regulations, the sales-weighted upstream emissions for Tesla’s 2013 passenger cars is 205 grams/mile and the upstream emissions associated with a comparable gasoline vehicle is 83 grams/mile. The difference, or the net upstream emissions of Tesla’s 2013 passenger car fleet, is 122 grams/mile.

²⁸ The upstream emission value for the Nissan Leaf is 141 grams/mile and the upstream emissions associated with a comparable gasoline vehicle is 71 grams/mile. The difference, or the net upstream emissions of the 2013 Leaf, is 70 grams/mile.

Table 3-4. Production Volumes of Advanced Technology Vehicles Using Zero Grams/Mile Incentive, by Model Year

| Manufacturer | 2010 | 2011 | 2012 | 2013 | Total |
|---------------|------------|---------------|---------------|---------------|----------------|
| BYD Motors | | | 11 | 32 | 43 |
| Coda | | | | 37 | 37 |
| Fiat Chrysler | | | | 2,353 | 2,353 |
| Fisker | | | 1,415 | | 1,415 |
| Ford | | | 653 | 18,654 | 19,307 |
| GM | | 4,370 | 18,355 | 27,484 | 50,209 |
| Honda | | | | 471 | 471 |
| Mercedes | | 546 | 25 | 880 | 1,451 |
| Mitsubishi | | | 1,435 | | 1,435 |
| Nissan | | 8,495 | 11,460 | 26,167 | 46,122 |
| Tesla | 599 | 269 | 2,952 | 17,813 | 21,633 |
| Toyota | | | 452 | 829 | 1,281 |
| Total | 599 | 13,680 | 36,758 | 94,720 | 145,757 |

2. Compressed Natural Gas Vehicles

The Honda Civic CNG was the only compressed natural gas (CNG) vehicle produced for general purchase by consumers in the 2012 and 2013 model years, and is a dedicated alternative fuel vehicle. EPA's GHG program contains a temporary incentive for CNG vehicles that applies through the 2015 model year. This incentive, which parallels the incentive offered these vehicles in the CAFE program, allows a CNG vehicle to be represented in the fleet average calculation by a reduced GHG value that is determined by measuring the tailpipe emission of the vehicle and then multiplying by 0.15. This is effectively the same incentive as under the CAFE program, except that fuel economy is divided, not multiplied, by 0.15.²⁹ The Civic CNG, which has actual tailpipe GHG emissions of 162 g/mi, is thus "counted" in Honda's fleet average passenger car calculation with a GHG emissions value of 24 g/mi. Although the vehicle-specific incentive is large (a reduction of 138 grams/mile), the net impact on Honda's car fleet is less than 0.01 grams/mile. This does not affect Honda's overall rounded car fleet average performance value, and likewise has an unnoticeable impact on the overall 2013 model year fleet. If the volume of CNG vehicles (either dual fuel or dedicated vehicles) increases substantially in the future, it will become more important for us to be able to separate out the impact of current and future incentives for these vehicles in a transparent manner.

3. Gasoline-Ethanol Flexible-Fuel Vehicles

The impact of FFVs is easy to determine because we calculate fleet average GHG values both with and without the incentives in order to ensure that no manufacturer exceeds the maximum allowable value of the incentive. Under the GHG program, EPA allows FFV credits intended to

²⁹ Use of the 0.15 factor for CNG sunsets after the 2015 model year. Starting with the 2017 model year a production multiplier incentive becomes effective. See 40 CFR 86.1866-12(b).

correspond to the amounts allowed in the CAFE program under the statutory provisions, but only for the 2012 to 2015 model years. As with the CAFE program, the GHG program bases FFV credits on the assumption that FFVs operate 50% of the time on the alternative fuel and 50% of the time on conventional fuel, resulting in CO₂ emissions that are based on an arithmetic average of alternative fuel and conventional fuel CO₂ emissions. The CO₂ emissions measurement on the alternative fuel is multiplied by a 0.15 factor. The 0.15 factor is used because, under the CAFE program, a gallon of alternative fuel is deemed to contain 0.15 gallons of gasoline fuel. Again, this approach is only applicable for the 2012–2015 model years of the GHG program.

For example, for a flexible-fuel vehicle that emits 330 g/mi CO₂ while operating on E-85 and 350 g/mi CO₂ while operating on gasoline, the resulting CO₂ level to be used in the manufacturer’s fleet average calculation would be:

$$\text{CO}_2 = \frac{[(330 \times 0.15) + 350]}{2} = 199.8 \text{ g/mi}$$

EPA realizes that by temporarily using the CAFE-based approach—including the 0.15 factor—the CO₂ emissions value for the vehicle is calculated to be significantly lower than it actually would be otherwise, even if the vehicle were assumed to operate on the alternative fuel at all times. This represents the short-term “incentive” being provided to FFVs. Under the GHG program, FFV credits are available only through the 2015 model year; starting in model year 2016, GHG compliance values are based on actual emissions performance of the FFV on conventional and alternative fuels, weighted by EPA’s assessment of the actual use of these fuels in FFVs.³⁰ In fact, the standards in the early years of the GHG program were developed with an explicit understanding that manufacturers would make use of this and other incentive and credit programs to meet the standards.

In the 2013 model year the dual-fuel credit limit in the CAFE program is 1.2 mpg across a manufacturer’s separate car and truck fleets (dedicated alternative fuel vehicles and vehicles that use electricity are not subject to this limit on credits). In other words, FFVs may not increase a manufacturer’s average fuel economy for its car or truck fleets by more than 1.2 mpg. To parallel the CAFE limitations, the GHG program contains a similar credit limit, but calculated in terms of CO₂ based on each manufacturer’s unique fleet average performance. EPA chose this approach because of the non-linearity between mpg and CO₂ emissions. For example, a 1.2 mpg increase from a base of 15 mpg represents a CO₂ decrease of about 44 g/mi, while a 1.2 mpg increase from a base of 30 mpg represents a CO₂ decrease of about 11 g/ mi. Thus, the CO₂ reduction that manufacturers may get from the FFV credits for a given fleet is limited to the CO₂ value comparable to 1.2 mpg and is calculated from a manufacturer’s specific fleet average performance value.

Seven manufacturers produced FFVs in the 2013 model year, as shown below in Tables 3-5 and 3-6. Clearly, Fiat Chrysler Automobiles, Ford, and GM produced the overwhelming majority of vehicles capable of operating on E85. Note that the number of models shown in Table 3-5 is based on EPA’s “model type” designation (used for EPA Fuel Economy and Environment

³⁰ EPA Guidance Letter “E85 Flexible Fuel Vehicle Weighting Factor for Model Year 2016-2018 Vehicles,” CD-14-18, November 12, 2014.

Labels), and is not equivalent to “nameplate.” Generally speaking, a model type is a unique combination of a nameplate (e.g., Silverado), an engine (e.g., 6 cylinder), a drive system (e.g., 4 wheel drive), and a transmission (e.g., 6-speed automatic). Thus a single nameplate that is offered with two engines, in both two- and four-wheel drive, and in manual and automatic transmissions, will result in eight different model types. For example, the four Nissan truck models shown in Table 3-5 are made up of two- and four-wheel drive versions of two nameplates, the Titan and the Armada.

Most of these manufacturers tended to focus their FFV production in the truck segment, and truck FFV production makes up nearly 70% of all FFV production in the 2013 model year. While all but Nissan increased FFV production in the 2013 model year, the increases from Ford and GM account for 80 percent of the overall increase in FFVs from 2012 to 2013. Although a small producer of FFVs, Volkswagen dramatically increased its investment in FFVs, more than doubling the number of models and increasing FFV production from about 2,000 in the 2012 model year to more than 50,000 vehicles in the 2013 model year.

Table 3-5. Number of FFV Models by Manufacturer, 2012-2013 Model Years

| Model Year | Category | Fiat Chrysler | Ford | GM | Mercedes | Nissan | Toyota | Volkswagen | Total |
|---------------|----------|---------------|------|----|----------|--------|--------|------------|-------|
| | | | | | | | | | |
| 2012 | Car | 10 | 7 | 19 | 5 | - | - | 4 | 45 |
| | Truck | 11 | 23 | 60 | 1 | 4 | 2 | - | 101 |
| | All | 21 | 30 | 79 | 6 | 4 | 2 | 4 | 146 |
| 2013 | Car | 10 | 6 | 18 | 7 | - | - | 10 | 51 |
| | Truck | 13 | 23 | 58 | 1 | 4 | 2 | 1 | 102 |
| | All | 23 | 29 | 76 | 8 | 4 | 2 | 11 | 153 |

Table 3-6. Production Volume of FFVs by Manufacturer, 2012-2013 Model Years

| Model Year | Category | Fiat Chrysler | Ford | GM | Mercedes | Nissan | Toyota | Volkswagen | Total |
|------------|----------|---------------|---------|-----------|----------|--------|--------|------------|-----------|
| 2012 | Car | 105,174 | 174,597 | 396,264 | 13,493 | - | - | 2,060 | 691,588 |
| | Truck | 453,399 | 323,563 | 511,183 | 8,289 | 24,154 | 31,670 | - | 1,352,258 |
| | All | 558,573 | 498,160 | 907,447 | 21,782 | 24,154 | 31,670 | 2,060 | 2,043,846 |
| 2013 | Car | 142,158 | 209,988 | 374,354 | 34,493 | - | - | 30,346 | 791,339 |
| | Truck | 431,359 | 546,695 | 637,576 | 22,082 | 13,650 | 33,203 | 20,799 | 1,705,364 |
| | All | 573,517 | 756,683 | 1,011,930 | 56,575 | 13,650 | 33,203 | 51,145 | 2,496,703 |

Table 3-7 shows the impact of FFVs on each manufacturer's fleet for the 2012 and 2013 model years. Fiat Chrysler, Ford, GM, and Mercedes all maximized the FFV credit in both car and truck fleets in the 2013 model year. Volkswagen likewise maximized FFV credits in their truck fleet. In other words, these manufacturers produced more than enough FFVs – or just enough – to claim the maximum FFV benefit. Even with Volkswagen's rapid increase in the deployment of FFVs, the overall impact of FFVs on the fleet as a whole remained steady from 2012 to 2013, at 8 g/mi.

Table 3-7. Net Credits Accrued From Use Of The FFV Incentives (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|--------------------|-----------------|-----------|----------|-----------------|-----------|----------|
| | Cars | Trucks | All | Cars | Trucks | All |
| Fiat Chrysler | 13* | 21* | 18 | 12* | 21* | 17 |
| Ford | 9 | 21* | 14 | 9* | 20* | 15 |
| GM | 11* | 23* | 16 | 10* | 22* | 15 |
| Mercedes | 11 | 15 | 13 | 12* | 12* | 12 |
| Nissan | 0 | 15 | 4 | 0 | 8 | 3 |
| Toyota | 0 | 9 | 4 | 0 | 8 | 4 |
| Volkswagen | 1 | 0 | 1 | 7 | 15* | 8 |
| Fleet Total | 4 | 14 | 8 | 4 | 14 | 8 |

*Achieved the maximum allowable FFV credit for this fleet.

D. Credits Based on Air Conditioning Systems

Over 99% of the new cars and light trucks in the United States are equipped with air conditioning (A/C) systems. There are two mechanisms by which A/C systems contribute to the emissions of greenhouse gases: through leakage of hydrofluorocarbon refrigerants into the atmosphere (sometimes called “direct emissions”) and through the consumption of fuel to

provide mechanical power to the A/C system (sometimes called “indirect emissions”). The high global warming potential of the current automotive refrigerant, HFC-134a, means that leakage of a small amount of refrigerant will have a far greater impact on global warming than emissions of a similar amount of CO₂. The impacts of refrigerant leakage can be reduced significantly by systems that incorporate leak-tight components, or, ultimately, by using a refrigerant with a lower global warming potential. The A/C system also contributes to increased tailpipe CO₂ emissions through the additional work required to operate the compressor, fans, and blowers. This additional power demand is ultimately met by using additional fuel, which is converted into CO₂ by the engine during combustion and exhausted through the tailpipe. These emissions can be reduced by increasing the overall efficiency of an A/C system, thus reducing the additional load on the engine from A/C operation, which in turn means a reduction in fuel consumption and a commensurate reduction in GHG emissions. Manufacturers may generate and use credits for improved A/C systems in complying with the CO₂ fleet average standards in the 2012 and later model years (or otherwise to be able to bank or trade the credits). These provisions were also used in the 2009-2011 model years to generate early credits, prior to the 2012 model year. Sixteen manufacturers used the A/C credit provisions – either for leakage reductions, efficiency improvements, or both – as part of their compliance demonstration in the 2013 model year.

The A/C provisions are structured as additional and optional credits, unlike the CO₂ standards for which manufacturers must demonstrate compliance using the EPA exhaust emission test procedures. The EPA compliance tests do not measure either A/C refrigerant leakage or the increase in tailpipe CO₂ emissions attributable to the additional engine load of A/C systems. Because it is optional to include A/C-related GHG emission reductions as an input to a manufacturer’s compliance demonstration, the A/C provisions are viewed as an additional program that credits manufacturers for implementing A/C technologies that result in real-world reductions in GHG emissions. A summary of the air conditioning credits reported by the industry for all model years, including the early credit program years, is shown in Table 3-8 (note that because not all manufacturers participated in the early credits program, credit volumes and percentages from 2009-2011 and 2012-2013 are not comparable). Table 3-9 shows the total air conditioning credits (combined leakage and efficiency credits, in Megagrams) reported by each manufacturer in the 2013 model year, and the grams/mile impact across their entire vehicle fleet. Like the TLAAS program and alternative fuel vehicle incentives, EPA’s standards are predicated in part upon manufacturers earning credits for reducing GHG emissions from A/C systems. Table 3-10 shows the benefit of air conditioning credits, translated from Megagrams to grams/mile, for each manufacturer’s fleet for the 2012 and 2013 model years.

Table 3-8. Reported Air Conditioning Credits by A/C Credit Type and Model Year

| Model Year | Leakage Credits | | Efficiency Credits | | Total (Mg) |
|--------------|-------------------|------------------------|--------------------|------------------------|-------------------|
| | Megagrams | % of Total A/C Credits | Megagrams | % of Total A/C Credits | |
| 2009 | 6,247,698 | 75% | 2,058,069 | 25% | 8,305,767 |
| 2010 | 8,323,530 | 75% | 2,731,927 | 25% | 11,055,457 |
| 2011 | 8,867,746 | 72% | 3,439,011 | 28% | 12,306,757 |
| 2012 | 11,096,821 | 66% | 5,803,156 | 34% | 16,899,977 |
| 2013 | 13,229,754 | 62% | 8,245,194 | 38% | 21,474,948 |
| Total | 47,765,549 | 68% | 22,277,357 | 32% | 70,042,906 |

Table 3-9. Reported Air Conditioning Credits by Manufacturer, 2013 Model Year

| Manufacturer | A/C Leakage Credits (Mg) | A/C Efficiency Credits (Mg) | Total A/C Credits (Mg) | Gram/Mile Equivalent of Total A/C Credits |
|--------------------|--------------------------|-----------------------------|------------------------|---|
| Aston Martin | 243 | 384 | 627 | 9 |
| BMW | 407,741 | 304,640 | 712,381 | 9 |
| Ferrari | 2,422 | 1,388 | 3,810 | 10 |
| Fiat Chrysler | 2,298,648 | 1,014,663 | 3,313,311 | 10 |
| Ford | 3,307,162 | 745,248 | 4,052,410 | 8 |
| GM | 3,294,795 | 1,238,996 | 4,533,791 | 9 |
| Honda | 569,957 | 505,625 | 1,075,582 | 4 |
| Hyundai | 477,903 | 603,761 | 1,081,664 | 5 |
| Jaguar Land Rover | 62,271 | 54,345 | 116,616 | 8 |
| Kia | 286,657 | 342,238 | 628,895 | 5 |
| Mercedes | 307,679 | 314,713 | 622,392 | 10 |
| Nissan | 202,036 | 813,915 | 1,015,951 | 4 |
| Tesla | | 19,826 | 19,826 | 6 |
| Toyota | 1,539,988 | 1,731,461 | 3,271,449 | 7 |
| Volkswagen | 369,092 | 498,037 | 867,129 | 7 |
| Volvo | 103,160 | 55,954 | 159,114 | 10 |
| Fleet Total | 13,229,754 | 8,245,194 | 21,474,948 | 7 |

Table 3-10. Net Impact of Air Conditioning Credits (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|--------------------|-----------------|--------|-----|-----------------|--------|-----|
| | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 9 | | 9 |
| BMW | 7 | 11 | 8 | 8 | 11 | 9 |
| Ferrari | 10 | | 10 | 10 | | 10 |
| Fiat Chrysler | 9 | 10 | 10 | 10 | 11 | 10 |
| Ford | 5 | 8 | 6 | 7 | 8 | 8 |
| GM | 8 | 8 | 8 | 9 | 9 | 9 |
| Honda | 3 | 4 | 3 | 3 | 5 | 4 |
| Hyundai | 4 | 7 | 5 | 5 | 7 | 5 |
| Jaguar Land Rover | 5 | 8 | 7 | 5 | 9 | 8 |
| Kia | 5 | 4 | 5 | 5 | 9 | 5 |
| Mercedes | 9 | 11 | 10 | 9 | 12 | 10 |
| Nissan | 2 | 4 | 3 | 4 | 4 | 4 |
| Tesla | 6 | | 6 | 6 | | 6 |
| Toyota | 7 | 6 | 7 | 7 | 7 | 7 |
| Volkswagen | 6 | 9 | 7 | 6 | 10 | 7 |
| Volvo | 10 | 12 | 11 | 10 | 11 | 10 |
| Fleet Total | 6 | 8 | 6 | 7 | 8 | 7 |

1. Air Conditioning Leakage Credits

A manufacturer choosing to generate A/C leakage credits with a specific A/C system is required to calculate a leakage “score” for the A/C system.³¹ This score is based on the number, performance, and technology of the components, fittings, seals, and hoses of the A/C system, and on the global warming potential (GWP) of the refrigerant.³² This score, which is determined in grams per year, is calculated using the procedures specified by the Society of Automotive Engineers Surface Vehicle Standard J2727. The score is subsequently converted to a grams/mile credit value for consistency with the units of GHG exhaust emissions. The grams/mile value is used to calculate the total tons of credits attributable to an A/C system by accounting for the VMT of the vehicle class (car or truck) and the production volume of the vehicles employing that A/C system.

In the 2012 model year, all leakage credits were based on improvements to the A/C system components, e.g., to O-rings, seals, valves, and fittings. In the 2013 model year both GM and Honda introduced vehicles that further reduce the impacts of A/C system leakage by using HFO-1234yf, a relatively new low-GWP refrigerant. These two manufacturers are the first to introduce

³¹ See 40 CFR 86.1867-12.

³² The global warming potential (GWP) represents how much a given mass of a chemical contributes to global warming over a given time period compared to the same mass of carbon dioxide. Carbon dioxide’s GWP is defined as 1.0.

this refrigerant in U.S. vehicle models. HFO-1234yf has an extremely low GWP of 4, as compared to a GWP of 1430 for HFC-134a, the refrigerant currently used throughout the industry. GM introduced HFO-1234yf in the Cadillac XTS and Honda implemented it in the Fit EV. Although the sales volumes of these vehicles are not high (about 42,000 for the XTS and about 500 for the Fit EV), the potential of low-GWP refrigerants is readily apparent. Using HFO-1234yf instead of HFC-134a effectively doubled the leakage credits generated by these models. For GM this meant a gain in leakage credits of about 56,000 Mg that would not be possible without the new refrigerant. Given that leakage credits for most manufacturers are in the range of 4-6 grams/mile using HFC-134a, the potential for additional credits – and real-world GHG reductions – is significant.

Fifteen manufacturers reported A/C leakage credits in the 2013 model year, as shown in Table 3-11. These manufacturers reported more than 13 million Mg of A/C leakage credits in 2013, almost one third of the total net credits reported for the model year, and accounting for about 4 grams/mile across the 2013 vehicle fleet. Table 3-12 shows the leakage credits in grams/mile for the 2012 and 2013 model years.

Table 3-11. Reported Air Conditioning Leakage Credits by Manufacturer and Fleet, 2013 Model Year (Mg)

| Manufacturer | Car | Truck | Total | Gram/Mile Equivalent of Total Credits |
|---------------------|------------------|------------------|-------------------|--|
| Aston Martin | 243 | | 243 | 3 |
| BMW | 251,534 | 156,207 | 407,741 | 5 |
| Ferrari | 2,422 | | 2,422 | 7 |
| Fiat Chrysler | 796,491 | 1,502,157 | 2,298,648 | 7 |
| Ford | 1,237,391 | 2,069,771 | 3,307,162 | 7 |
| GM* | 1,775,294 | 1,519,501 | 3,294,795 | 7 |
| Honda* | 264,376 | 305,581 | 569,957 | 2 |
| Hyundai | 445,426 | 32,477 | 477,903 | 2 |
| Jaguar Land Rover | 8,359 | 53,912 | 62,271 | 4 |
| Kia | 264,796 | 21,861 | 286,657 | 2 |
| Mercedes | 175,482 | 132,197 | 307,679 | 5 |
| Nissan | 38,523 | 163,513 | 202,036 | 1 |
| Toyota | 816,463 | 723,525 | 1,539,988 | 3 |
| Volkswagen | 290,530 | 78,562 | 369,092 | 3 |
| Volvo | 51,622 | 51,538 | 103,160 | 7 |
| Fleet Total | 6,418,952 | 6,810,802 | 13,229,754 | 4 |

* Some vehicles equipped with systems using HFO-1234yf, a low-GWP refrigerant.

Table 3-12. Air Conditioning Leakage Credits (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|--------------------|-----------------|----------|----------|-----------------|----------|----------|
| | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 3 | | 3 |
| BMW | 4 | 7 | 5 | 4 | 7 | 5 |
| Ferrari | 6 | | 6 | 7 | | 7 |
| Fiat Chrysler | 6 | 8 | 7 | 6 | 8 | 7 |
| Ford | 4 | 7 | 6 | 5 | 7 | 7 |
| GM | 6 | 7 | 6 | 6 | 7 | 7 |
| Honda | 1 | 2 | 2 | 1 | 3 | 2 |
| Hyundai | 2 | 4 | 2 | 2 | 4 | 2 |
| Jaguar Land Rover | 3 | 4 | 4 | 3 | 5 | 4 |
| Kia | 2 | 3 | 2 | 2 | 6 | 2 |
| Mercedes | 4 | 7 | 5 | 4 | 7 | 5 |
| Nissan | 0 | 2 | 1 | 0 | 2 | 1 |
| Toyota | 3 | 3 | 3 | 3 | 3 | 3 |
| Volkswagen | 2 | 4 | 2 | 3 | 5 | 3 |
| Volvo | 6 | 8 | 7 | 6 | 7 | 7 |
| Fleet Total | 3 | 6 | 4 | 4 | 6 | 4 |

2. Air Conditioning Efficiency Credits

Manufacturers that make improvements in their air conditioning systems to increase efficiency, and thus reduce CO₂ emissions due to air conditioning system operation, may be eligible for air conditioning efficiency credits. Most of the additional load on the engine from air conditioning systems comes from the compressor, which pressurizes the refrigerant and pumps it around the system loop. A significant additional load on the engine may also come from electric or hydraulic fans, which are used to move air across the condenser, and from the electric blower, which is used to move air across the evaporator and into the cabin. Manufacturers have several technological options for improving efficiency, including more efficient compressors, fans, and motors, and system controls that avoid over-chilling the air (and subsequently re-heating it to provide the desired air temperature with an associated loss of efficiency). For vehicles equipped with automatic climate-control systems, real-time adjustment of several aspects of the overall system (such as engaging the full capacity of the cooling system only when it is needed, and maximizing the use of recirculated air) can result in improved efficiency. The regulations provide manufacturers with a “menu” of technologies and associated credit values (in grams/mile of CO₂). The total tons of credits are then based on the total volume of vehicles in a model year using these technologies.

Sixteen manufacturers used the provisions that allow credits based on improvements to the overall efficiency of the A/C system, as shown in Table 3-13. These manufacturers reported a total of more than 8 million Mg of CO₂ A/C efficiency credits in the 2013 model year, or about 20% of the total net credits reported by the industry and accounting for about 3 grams per mile

across the 2013 fleet. Table 3-14 shows the efficiency credits in grams/mile for the 2012 and 2013 model years.

Table 3-13. Reported Air Conditioning Efficiency Credits by Manufacturer and Fleet, 2013 Model Year (Mg)

| Manufacturer | Car | Truck | Total | Grams/Mile Equivalent of Total Credits |
|---------------------|------------------|------------------|------------------|---|
| Aston Martin | 384 | | 384 | 5 |
| BMW | 208,519 | 96,121 | 304,640 | 4 |
| Ferrari | 1,388 | | 1,388 | 4 |
| Fiat Chrysler | 421,109 | 593,554 | 1,014,663 | 3 |
| Ford | 461,932 | 283,316 | 745,248 | 1 |
| GM | 821,301 | 417,695 | 1,238,996 | 3 |
| Honda | 324,172 | 181,453 | 505,625 | 2 |
| Hyundai | 571,743 | 32,018 | 603,761 | 3 |
| Jaguar Land Rover | 6,780 | 47,565 | 54,345 | 4 |
| Kia | 329,198 | 13,040 | 342,238 | 3 |
| Mercedes | 207,180 | 107,533 | 314,713 | 5 |
| Nissan | 623,973 | 189,942 | 813,915 | 3 |
| Tesla | 19,826 | | 19,826 | 6 |
| Toyota | 1,053,911 | 677,550 | 1,731,461 | 4 |
| Volkswagen | 417,724 | 80,313 | 498,037 | 4 |
| Volvo | 30,611 | 25,343 | 55,954 | 4 |
| Fleet Total | 5,499,751 | 2,745,443 | 8,245,194 | 3 |

Table 3-14. Air Conditioning Efficiency Credits (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|--------------------|-----------------|----------|----------|-----------------|----------|----------|
| | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 5 | | 5 |
| BMW | 3 | 4 | 3 | 4 | 4 | 4 |
| Ferrari | 4 | | 4 | 4 | | 4 |
| Fiat Chrysler | 3 | 2 | 3 | 3 | 3 | 3 |
| Ford | 0 | 0 | 0 | 2 | 1 | 1 |
| GM | 2 | 1 | 2 | 3 | 2 | 3 |
| Honda | 2 | 2 | 2 | 2 | 2 | 2 |
| Hyundai | 3 | 3 | 3 | 3 | 4 | 3 |
| Jaguar Land Rover | 2 | 4 | 4 | 2 | 4 | 4 |
| Kia | 3 | 1 | 3 | 3 | 3 | 3 |
| Mercedes | 5 | 5 | 5 | 5 | 5 | 5 |
| Nissan | 2 | 2 | 2 | 3 | 2 | 3 |
| Tesla | 6 | | 6 | 6 | | 6 |
| Toyota | 4 | 2 | 3 | 4 | 3 | 4 |
| Volkswagen | 4 | 5 | 4 | 4 | 5 | 4 |
| Volvo | 4 | 4 | 4 | 4 | 4 | 4 |
| Fleet Total | 2 | 2 | 2 | 3 | 2 | 3 |

E. Credits Based On “Off-Cycle” Technology

“Off-cycle” emission reductions can be achieved by employing technologies that result in real-world benefits, but where that benefit is not adequately or entirely captured on the test procedures used by manufacturers to demonstrate compliance with emission standards. EPA’s light-duty vehicle greenhouse gas program acknowledges these benefits by giving automobile manufacturers several options for generating “off-cycle” carbon dioxide (CO₂) credits. EPA’s light-duty vehicle greenhouse gas (GHG) program provides three pathways by which a manufacturer may accrue off-cycle CO₂ credits. The first is a predetermined list of credit values for specific off-cycle technologies that may be used beginning in model year 2014.³³ This pathway allows manufacturers to use conservative credit values established by EPA for a wide range of technologies, with minimal data submittal or testing requirements. In cases where additional laboratory testing can demonstrate emission benefits, a second pathway allows manufacturers to use a broader array of emission tests (known as “5-cycle” testing because the methodology uses five different testing procedures) to demonstrate and justify off-cycle CO₂ credits.³⁴ The additional emission tests allow emission benefits to be demonstrated over some elements of real-world driving not captured by the GHG compliance tests, including high speeds, rapid accelerations, and cold temperatures. Credits determined according to this methodology do not undergo additional public review. The third and last pathway allows manufacturers to seek

³³ See 40 CFR 86.1869-12(b).

³⁴ See 40 CFR 86.1869-12(c).

EPA approval to use an alternative methodology for determining the off-cycle CO₂ credits.³⁵ This option is only available if the benefit of the technology cannot be adequately demonstrated using the 5-cycle methodology. Manufacturers may also use this option for model years prior to 2014 to demonstrate off-cycle CO₂ reductions for technologies that are on the predetermined list, or to demonstrate reductions that exceed those available via use of the predetermined list.

As was the case in the 2012 model year, GM is the only manufacturer to have requested and been granted off-cycle credits. These credits are for a technology used on certain GM gasoline-electric hybrid vehicles. The technology is an auxiliary electric pump, which keeps engine coolant circulating in cold weather while the vehicle is stopped and the engine is off. GM received off-cycle credits in the early credits program for hybrid full size pick-up trucks that were equipped with this technology. In the 2012 model year, the technology was expanded to include two Buick hybrid passenger car models. In the 2013 model year the technology was applied to GM's full-size hybrid trucks as well as the Buick LaCrosse, Buick Regal, and Chevrolet Malibu models equipped with GM's "eAssist" technology (about 2,000 trucks and 45,000 cars). These vehicles feature engine stop/start capability for improved fuel economy, and as a result the engine can frequently be turned off when the vehicle is stopped, such as at a traffic light, resulting in real-world fuel savings. However, during cold weather, a hybrid vehicle without the auxiliary heater pump would need to keep the engine idling during the stop periods solely to maintain coolant flow to the heater to maintain a comfortable temperature inside the vehicle. This would reduce the fuel economy benefits of the stop/start feature during cold weather, which is an "off-cycle" temperature condition not captured by the greenhouse gas test methods. The off-cycle credits reported by GM in the 2009-2013 model years are shown in Table 3-15. The calculated gram/mile benefit rounds to zero because of the low volume of these credits, thus the table does not display these credits in equivalent grams/mile.

Table 3-15. Off-Cycle Credits Reported by GM (Mg)

| Model Year | Car | Truck | Total |
|-------------------|---------------|--------------|---------------|
| 2009 | - | 3,329 | 3,329 |
| 2010 | - | 965 | 965 |
| 2011 | - | 1,338 | 1,338 |
| 2012 | 4,984 | 838 | 5,822 |
| 2013 | 13,330 | 819 | 14,149 |
| Total | 18,314 | 7,289 | 25,603 |

In the fall of 2013, Mercedes requested off-cycle credits for the following technologies in use or planned for implementation in the 2012-2016 model years: stop-start systems, high-efficiency lighting, infrared glass glazing, and active seat ventilation. Per the regulations, EPA sought public comment on Mercedes' proposed methodology, and considered those public comments in making a final determination on the level of off-cycle credits for these Mercedes technologies. EPA approved methodologies for Mercedes to determine these off-cycle credits in September of

³⁵ See 40 CFR 86.1869-12(d).

2014.³⁶ Although the credits were approved for use in the 2012-2016 model years, we do not expect (or require) data to be submitted until the 2014 model year data is due at the end of the first quarter of 2015. Thus, Mercedes off-cycle credits do not appear in this report and will be presented in subsequent GHG performance reports issued by EPA.

F. Deficits Based On Methane and Nitrous Oxide Standards

EPA finalized emission standards for methane (CH₄) and nitrous oxide (N₂O) emissions as part of the rule setting the 2012-2016 model year GHG standards. The standards that were set in that rulemaking were 0.010 grams/mile for N₂O and 0.030 grams/mile for CH₄. These standards were established to cap emissions of GHGs, given that current levels of CH₄ and N₂O are generally significantly below these established standards. These capping standards were intended to prevent future increases in emissions of these GHGs, and were generally not expected to result in the application of new technologies or significant costs for manufacturers using current designs.

There are three different ways for a manufacturer to demonstrate compliance with these standards. First, and used by most manufacturers, manufacturers may demonstrate compliance with these standards with test data as they do for all other non-GHG emission standards. Because there are no credits or deficits involved with this approach, and there are no consequences with respect to the CO₂ fleet average calculation, the manufacturers are not required to submit this data as part of their GHG reporting and hence this GHG compliance report does not include information from manufacturers using this option. Second, EPA also allows an alternative CO₂-equivalent standard option, which manufacturers may choose in lieu of complying with the cap standards. This CO₂-equivalent standard option allows manufacturers to include CH₄ and N₂O, on a CO₂-equivalent basis, in their CO₂ emissions fleet average compliance level. This is done without adjusting the fleet average CO₂ standard to account for the addition of CH₄ and N₂O emissions. Manufacturers that choose this option are required to include the CH₄ and N₂O emissions of all their vehicles for the purpose of calculating their fleet average. In other words, the value of CREE (the carbon-related exhaust emissions, as described earlier) for these manufacturers will include CO₂, hydrocarbons, and carbon monoxide, as well as CH₄ and N₂O emissions (which are adjusted to account for their higher global warming potential than CO₂), for all their vehicles. Three manufacturers chose to use this approach in the 2013 model year: Nissan, Mazda, and Subaru.

A third alternative to meeting the CH₄ and N₂O standards was initially limited to the 2012-2014 model years, but was subsequently expanded to include all model years of the program. Under this approach, manufacturers can essentially define an alternative, less stringent CH₄ and/or N₂O standard for any vehicle that may have difficulty meeting the specific standards. This alternative standard is treated as any other emission standard in that it must be met for the full useful life of the vehicle. This method provides some additional flexibility relative to the other two options in that (1) a manufacturer can target specific vehicles for alternative standards without incurring a fleet-wide impact, and (2) CH₄ and N₂O are delinked, in that a manufacturer can meet the default regulatory standard for one and select an alternative standard for the other. However, the key

³⁶ “EPA Decision Document: Mercedes-Benz Off-cycle Credits for MYs 2012-2016,” U.S. EPA-420-R-14-025, Office of Transportation and Air Quality, September 2014. See <http://www.epa.gov/otaq/regs/ld-hwy/greenhouse/documents/420r14025.pdf>.

aspect of this approach is that manufacturers that use it must calculate a deficit (in Megagrams) based on the less stringent standards and on the production volumes of the vehicles to which those standards apply. Five manufacturers made use of the flexibility offered by this approach, as shown in Table 3-16. Like any other deficit, these deficits must ultimately be offset by CO₂ credits. While these deficits could be carried forward to the next three model years like other deficits, all of the manufacturers using this approach were able to cover these incremental deficits with credits, either carried forward from 2009-2012 or generated in 2013.

Table 3-16. Reported CH₄ and N₂O Deficits by Manufacturer and Fleet, 2013 Model Year (Mg)

| Manufacturer | Car | | Truck | | Total | Grams/Mile Equivalent of Total |
|--------------------|------------------|------------------|------------------|------------------|------------------|--------------------------------|
| | CH ₄ | N ₂ O | CH ₄ | N ₂ O | | |
| BMW | | | (1,287) | (5,115) | (6,402) | 0.1 |
| Fiat Chrysler | (5,058) | | (190) | | (5,248) | 0.0 |
| Ford | (12,412) | (9,795) | (49,342) | (252,940) | (324,489) | 0.6 |
| GM | (27,545) | | (89,000) | | (116,545) | 0.2 |
| Volkswagen | (57,902) | (150,195) | (434) | (10,889) | (219,420) | 1.8 |
| Fleet Total | (102,917) | (159,990) | (140,253) | (268,944) | (672,104) | 0.2 |

Tables 3-17 and 3-18 show the gram/mile equivalent CH₄ and N₂O deficits, respectively, for the 2012 and 2013 model years. As in all of the tables in this document, the final Fleet Total row indicates the impact across the entire fleet, including manufacturers and vehicles that did not participate in the alternative CH₄ and/or N₂O standards.

Table 3-17. CH₄ Deficits (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|--------------------|-----------------|------------|------------|-----------------|------------|------------|
| | Cars | Trucks | All | Cars | Trucks | All |
| BMW | 0.0 | 0.3 | 0.1 | 0.0 | 0.1 | 0.0 |
| Fiat Chrysler | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| Ford | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 |
| GM | 0.1 | 0.4 | 0.2 | 0.1 | 0.4 | 0.2 |
| Volkswagen | 0.6 | 0.1 | 0.5 | 0.5 | 0.0 | 0.5 |
| Fleet Total | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |

Table 3-18. N₂O Deficits (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | |
|--------------------|-----------------|------------|------------|-----------------|------------|------------|
| | Cars | Trucks | All | Cars | Trucks | All |
| BMW | 0.0 | 1.1 | 0.3 | 0.0 | 0.2 | 0.1 |
| Fiat Chrysler | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ford | 0.0 | 0.9 | 0.4 | 0.0 | 0.9 | 0.5 |
| Volkswagen | 1.4 | 1.2 | 1.4 | 1.4 | 0.7 | 1.3 |
| Fleet Total | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 |

G. 2013 Model Year Compliance Values

As described at the outset of this section, there are a number of “building blocks” that are assembled to describe a manufacturer’s performance in a given model year. These elements cumulatively make up a manufacturer’s “compliance value,” i.e., the performance value specific to a given model year and fleet that is compared to an emissions standard (or target) to determine whether a fleet generates a net credit or deficit balance in that model year. Table 3-19 summarizes all of these building blocks (described in previous sections) for the 2013 model year fleet for each manufacturer. The values in Table 3-19 are calculated for each manufacturer’s combined car and truck fleet by weighting car and truck values according to the relative production volumes and VMT of cars and trucks.³⁷ The final row shows values for the total 2013 fleet. Note that the compliance value for each manufacturer can be derived from the values in the table by applying the credits and deficits to the 2-cycle tailpipe value.³⁸ For example, Volkswagen’s 2-cycle tailpipe emissions of 279 grams/mile is reduced by applying FFV and A/C credits totaling 15 grams/mile and then increased by 2 grams/mile as a result of their use of N₂O and CH₄ alternative standards, yielding a final compliance value of 266 grams/mile (any apparent mathematical differences are the result of rounding). Tables 3-20 and 3-21 show the same information for car and truck fleets, respectively.³⁹ The resulting compliance values can then be compared to the target values for each fleet to determine whether a manufacturer generates credits or deficits in the 2013 model year.

³⁷ The compliance and target values do not represent official regulatory values. Regulatory target values are determined separately for car and truck fleets. The compliance value is not a regulatory value, but rather is a calculated value based on each manufacturers’ unique car and truck sales weighting for a given model year, and is shown as a way of portraying the cumulative impact of a manufacturer’s tailpipe performance and any optional credits used by a manufacturer.

³⁸ This is true for all except manufacturers using the Temporary Lead-time Allowance Alternative Standards. The TLAAS credit shown is an accurate representation of the “benefit” received from using less stringent standards, but because it is not an actual credit but rather an adjustment to the standard, it is not deducted from the 2-cycle tailpipe value like other credits.

³⁹ Versions of Tables 3-19, 3-20, and 3-21 for the 2012 model year are shown in Appendix C.

Table 3-19. 2013 Compliance Values - Combined Passenger Car & Light Truck Fleet (g/mi)

| Manufacturer | 2-Cycle Tailpipe | Credits (g/mi) | | | | CH ₄ & N ₂ O Deficit | Compliance Value |
|---------------------|------------------|----------------|----------|----------|-----------|--|------------------|
| | | FFV | TLAAS | A/C | Off-Cycle | | |
| Aston Martin | 444 | 0 | 64 | 9 | 0 | 0 | 435 |
| BMW | 292 | 0 | 0 | 9 | 0 | 0 | 283 |
| BYD Motors | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coda | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ferrari | 475 | 0 | 66 | 10 | 0 | 0 | 465 |
| Fiat Chrysler | 344 | 17 | 0 | 10 | 0 | 0 | 316 |
| Ford | 321 | 15 | 0 | 8 | 0 | 1 | 299 |
| GM | 325 | 15 | 0 | 9 | 0 | 0 | 301 |
| Honda | 257 | 0 | 0 | 4 | 0 | 0 | 254 |
| Hyundai | 241 | 0 | 0 | 5 | 0 | 0 | 236 |
| Jaguar Land Rover | 398 | 0 | 47 | 8 | 0 | 0 | 390 |
| Kia | 254 | 0 | 0 | 5 | 0 | 0 | 248 |
| Lotus | 334 | 0 | 62 | 0 | 0 | 0 | 334 |
| Mazda | 251 | 0 | 0 | 0 | 0 | 0 | 251 |
| McLaren | 374 | 0 | 66 | 0 | 0 | 0 | 374 |
| Mercedes | 321 | 12 | 9 | 10 | 0 | 0 | 299 |
| Mitsubishi | 258 | 0 | 0 | 0 | 0 | 0 | 258 |
| Nissan | 266 | 3 | 0 | 4 | 0 | 0 | 260 |
| Porsche | 336 | 0 | 73 | 0 | 0 | 0 | 336 |
| Subaru | 264 | 0 | 0 | 0 | 0 | 0 | 264 |
| Suzuki | 273 | 0 | 0 | 0 | 0 | 0 | 273 |
| Tesla ⁴⁰ | 0 | 0 | 0 | 6 | 0 | 0 | -6 |
| Toyota | 278 | 4 | 0 | 7 | 0 | 0 | 268 |
| Volkswagen | 279 | 8 | 0 | 7 | 0 | 2 | 266 |
| Volvo | 318 | 0 | 0 | 10 | 0 | 0 | 307 |
| Fleet Total | 294 | 8 | 1 | 7 | 0 | 0 | 279 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

⁴⁰ Tesla manufactures only electric vehicles. As explained in section 3.C.1, a temporary incentive for electric vehicles allows electric vehicle tailpipe emissions to be set equal to zero grams/mile, as shown in this table. An artifact of this is that Tesla's compliance value is represented by a negative number after applying air conditioning credits.

Table 3-20. 2013 Compliance Values - Passenger Car Fleet (g/mi)

| Manufacturer | 2-Cycle Tailpipe | Credits (g/mi) | | | | CH ₄ & N ₂ O Deficit | Compliance Value |
|---------------------|------------------|----------------|----------|----------|-----------|--|------------------|
| | | FFV | TLAAS | A/C | Off-Cycle | | |
| Aston Martin | 444 | 0 | 64 | 9 | 0 | 0 | 435 |
| BMW | 271 | 0 | 0 | 8 | 0 | 0 | 263 |
| BYD Motors | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coda | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ferrari | 475 | 0 | 66 | 10 | 0 | 0 | 465 |
| Fiat Chrysler | 289 | 12 | 0 | 10 | 0 | 0 | 268 |
| Ford | 256 | 9 | 0 | 7 | 0 | 0 | 240 |
| GM | 273 | 10 | 0 | 9 | 0 | 0 | 254 |
| Honda | 228 | 0 | 0 | 3 | 0 | 0 | 225 |
| Hyundai | 238 | 0 | 0 | 5 | 0 | 0 | 233 |
| Jaguar Land Rover | 342 | 0 | 41 | 5 | 0 | 0 | 337 |
| Kia | 252 | 0 | 0 | 5 | 0 | 0 | 247 |
| Lotus | 334 | 0 | 62 | 0 | 0 | 0 | 334 |
| Mazda | 232 | 0 | 0 | 0 | 0 | 0 | 232 |
| McLaren | 374 | 0 | 66 | 0 | 0 | 0 | 374 |
| Mercedes | 296 | 12 | 0 | 9 | 0 | 0 | 275 |
| Mitsubishi | 254 | 0 | 0 | 0 | 0 | 0 | 254 |
| Nissan | 232 | 0 | 0 | 4 | 0 | 0 | 228 |
| Porsche | 309 | 0 | 63 | 0 | 0 | 0 | 309 |
| Subaru | 254 | 0 | 0 | 0 | 0 | 0 | 254 |
| Suzuki | 266 | 0 | 0 | 0 | 0 | 0 | 266 |
| Tesla ⁴¹ | 0 | 0 | 0 | 6 | 0 | 0 | -6 |
| Toyota | 224 | 0 | 0 | 7 | 0 | 0 | 217 |
| Volkswagen | 272 | 7 | 0 | 6 | 0 | 2 | 260 |
| Volvo | 292 | 0 | 0 | 10 | 0 | 0 | 282 |
| Fleet Total | 251 | 4 | 0 | 7 | 0 | 0 | 241 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

⁴¹ Tesla manufactures only electric vehicles. As explained in section 3.C.1, a temporary incentive for electric vehicles allows electric vehicle tailpipe emissions to be set equal to zero grams/mile, as shown in this table. An artifact of this is that Tesla's compliance value is represented by a negative number after applying air conditioning credits.

Table 3-21. 2013 Compliance Values - Light Truck Fleet (g/mi)

| Manufacturer | 2-Cycle Tailpipe | Credits (g/mi) | | | | CH ₄ & N ₂ O Deficit | Compliance Value |
|--------------------|------------------|----------------|----------|----------|-----------|--|------------------|
| | | FFV | TLAAS | A/C | Off-Cycle | | |
| BMW | 346 | 0 | 0 | 11 | 0 | 0 | 335 |
| Fiat Chrysler | 380 | 21 | 0 | 11 | 0 | 0 | 348 |
| Ford | 375 | 20 | 0 | 8 | 0 | 0 | 348 |
| GM | 395 | 22 | 0 | 9 | 0 | 0 | 364 |
| Honda | 312 | 0 | 0 | 5 | 0 | 0 | 307 |
| Hyundai | 317 | 0 | 0 | 7 | 0 | 0 | 310 |
| Jaguar Land Rover | 414 | 0 | 49 | 9 | 0 | 0 | 405 |
| Kia | 301 | 0 | 0 | 9 | 0 | 0 | 292 |
| Mazda | 296 | 0 | 0 | 0 | 0 | 0 | 296 |
| Mercedes | 371 | 12 | 27 | 12 | 0 | 0 | 347 |
| Mitsubishi | 267 | 0 | 0 | 0 | 0 | 0 | 267 |
| Nissan | 340 | 8 | 0 | 4 | 0 | 0 | 328 |
| Porsche | 363 | 0 | 82 | 0 | 0 | 0 | 363 |
| Subaru | 270 | 0 | 0 | 0 | 0 | 0 | 270 |
| Suzuki | 330 | 0 | 0 | 0 | 0 | 0 | 330 |
| Toyota | 347 | 8 | 0 | 7 | 0 | 0 | 332 |
| Volkswagen | 327 | 15 | 0 | 10 | 0 | 0 | 302 |
| Volvo | 348 | 0 | 0 | 11 | 0 | 0 | 337 |
| Fleet Total | 360 | 14 | 1 | 8 | 0 | 0 | 339 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

Table 3-22 shows the calculated compliance values for each manufacturer's car and truck fleet for the 2012 and 2013 model years. As can be seen in the table, there were widespread decreases in compliance values from 2012 to 2013, resulting in a net decrease of 8 grams/mile (about three percent) across the fleet of combined cars and trucks.

Table 3-22. 2012-2013 Model Year Compliance Values by Manufacturer and Fleet (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | | Change: 2012 to 2013 | | |
|---------------------|-----------------|------------|------------|-----------------|------------|------------|----------------------|------------|-----------|
| | Cars | Trucks | All | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 435 | | 435 | | | |
| BMW | 270 | 353 | 294 | 263 | 335 | 283 | -7 | -18 | -11 |
| BYD Motors | 0 | | 0 | 0 | | 0 | 0 | | 0 |
| Coda | 0 | | 0 | 0 | | 0 | 0 | | 0 |
| Ferrari | 484 | | 484 | 465 | | 465 | -19 | | -19 |
| Fiat Chrysler | 278 | 353 | 329 | 268 | 348 | 316 | -10 | -5 | -13 |
| Fisker | 146 | | 146 | | | | | | |
| Ford | 248 | 357 | 295 | 240 | 348 | 299 | -8 | -10 | 4 |
| GM | 264 | 366 | 307 | 254 | 364 | 301 | -10 | -2 | -7 |
| Honda | 234 | 316 | 263 | 225 | 307 | 254 | -9 | -9 | -9 |
| Hyundai | 239 | 305 | 244 | 233 | 310 | 236 | -6 | 5 | -8 |
| Jaguar Land Rover | 371 | 431 | 419 | 337 | 405 | 390 | -34 | -26 | -29 |
| Kia | 253 | 320 | 261 | 247 | 292 | 248 | -6 | -28 | -12 |
| Lotus | | | | 334 | | 334 | | | |
| Mazda | 241 | 324 | 263 | 232 | 296 | 251 | -9 | -28 | -12 |
| McLaren | | | | 374 | | 374 | | | |
| Mercedes | 295 | 367 | 320 | 275 | 347 | 299 | -21 | -19 | -22 |
| Mitsubishi | 262 | 283 | 267 | 254 | 267 | 258 | -8 | -16 | -8 |
| Nissan | 256 | 363 | 288 | 228 | 328 | 260 | -28 | -36 | -28 |
| Porsche | 325 | 362 | 342 | 309 | 363 | 336 | -16 | 1 | -6 |
| Subaru | 257 | 296 | 282 | 254 | 270 | 264 | -3 | -26 | -18 |
| Suzuki | 267 | 361 | 287 | 266 | 330 | 273 | -1 | -31 | -14 |
| Tesla ⁴² | -6 | | -6 | -6 | | -6 | 0 | | 0 |
| Toyota | 214 | 339 | 263 | 217 | 332 | 268 | 3 | -7 | 5 |
| Volkswagen | 269 | 322 | 276 | 260 | 303 | 266 | -9 | -19 | -10 |
| Volvo | 287 | 331 | 300 | 282 | 337 | 308 | -5 | 6 | 8 |
| Fleet Total | 249 | 348 | 288 | 241 | 339 | 279 | -9 | -10 | -9 |

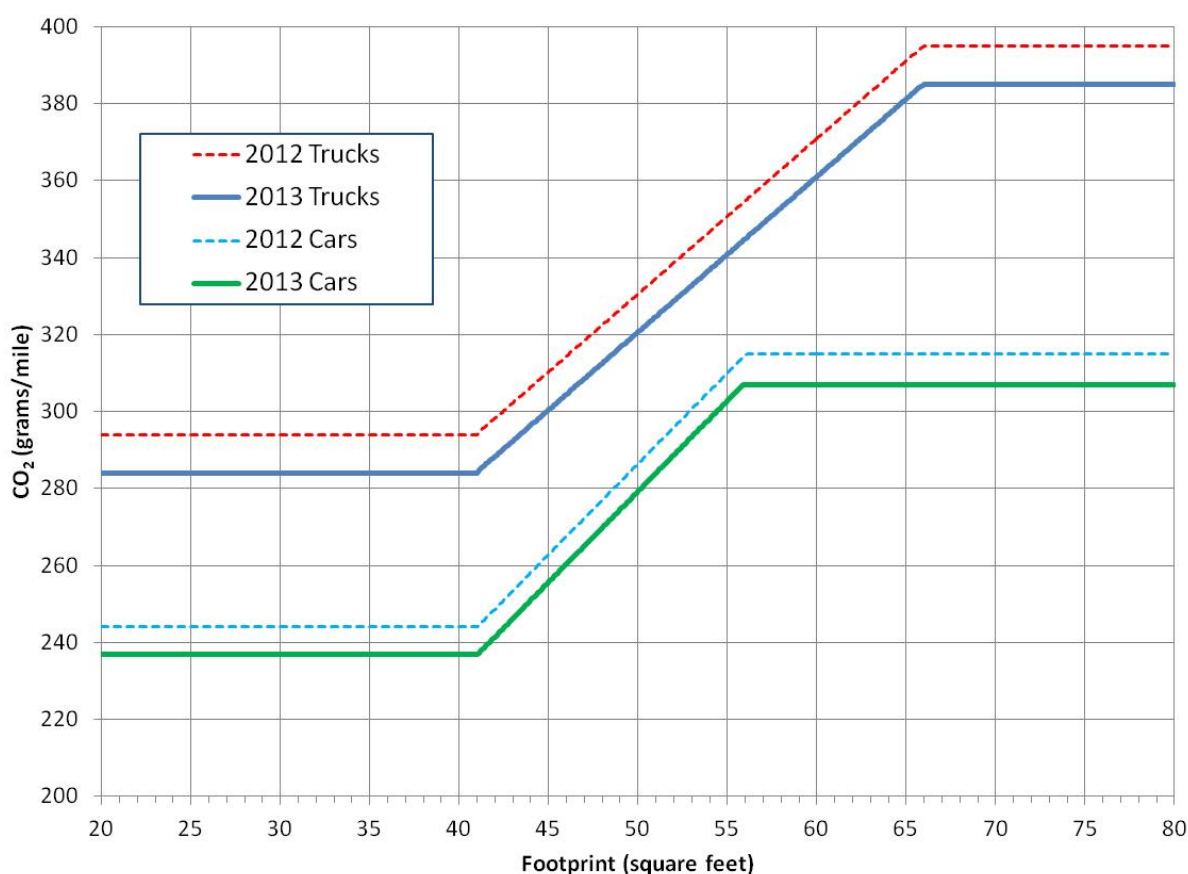
H. 2013 Model Year Footprint-Based CO₂ Standards

The final values needed to determine the relative performance for a manufacturer in a model year are the emissions standards that apply to each manufacturer's fleets in that model year. At the end of each model year, manufacturers calculate unique CO₂ standards for each fleet (cars and

⁴² Tesla manufactures only electric vehicles. As explained in section 3.C.1, a temporary incentive for electric vehicles allows electric vehicle tailpipe emissions to be set equal to zero grams/mile, as shown in this table. An artifact of this is that Tesla's compliance value is represented by a negative number after applying air conditioning credits.

trucks) using equations specified in the regulations based on the footprint of their vehicles.⁴³ The footprint “curves” for the 2012 and 2013 model years are shown in Figure 3-1. The unique CO₂ standard for each manufacturer’s fleet is a production-weighted average of the CO₂ target values determined from the curves based on all of the unique footprint values for the vehicles in a manufacture’s fleet.

Figure 3-1. 2012-2013 Model Year CO₂ Footprint Target Curves



The calculated CO₂ standards for the 2012 and 2013 model years are shown in Table 3-23. Manufacturers use these unique footprint-based car and truck standards – which are required by regulation – to determine their compliance status. A third value for each manufacturer – a sales- and VMT-weighted standard for the combined car and truck fleet – is provided for convenience and comparative purposes, but it is not a compliance value required by the regulations. Similar to the compliance values described in the previous section, there were widespread decreases in the CO₂ standards from 2012 to 2013, representing an increase in the overall stringency of the program.

⁴³ A vehicle’s footprint is defined specifically in regulations as the product of vehicle track width and wheelbase, but it can be simply viewed as the area of the rectangle enclosed by the four points where the tires touch the ground.

Table 3-23. 2012-2013 Model Year CO₂ Standards by Manufacturer and Fleet (g/mi)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | | Change: 2012 to 2013 | | |
|--------------------|-----------------|------------|------------|-----------------|------------|------------|----------------------|-----------|-----------|
| | Cars | Trucks | All | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 321 | | 321 | | | |
| BMW | 269 | 336 | 288 | 263 | 324 | 280 | -6 | -12 | -8 |
| BYD Motors | 277 | | 277 | 269 | | 269 | -8 | | -8 |
| Coda | 246 | | 246 | 239 | | 239 | -7 | | -7 |
| Ferrari | 345 | | 345 | 331 | | 331 | -14 | | -14 |
| Fiat Chrysler | 277 | 345 | 323 | 270 | 338 | 311 | -7 | -7 | -12 |
| Fisker | 315 | | 315 | | | | | | |
| Ford | 265 | 364 | 308 | 265 | 355 | 315 | 0 | -9 | 6 |
| GM | 272 | 369 | 313 | 263 | 360 | 304 | -9 | -9 | -9 |
| Honda | 263 | 333 | 288 | 256 | 318 | 278 | -7 | -15 | -10 |
| Hyundai | 269 | 316 | 273 | 261 | 309 | 263 | -8 | -7 | -10 |
| Jaguar Land Rover | 364 | 388 | 383 | 324 | 362 | 353 | -40 | -26 | -30 |
| Kia | 266 | 338 | 274 | 258 | 303 | 259 | -8 | -35 | -15 |
| Lotus | | | | 311 | | 311 | | | |
| Mazda | 259 | 323 | 276 | 250 | 311 | 268 | -9 | -12 | -8 |
| McLaren | | | | 329 | | 329 | | | |
| Mercedes | 277 | 360 | 306 | 262 | 354 | 292 | -15 | -6 | -14 |
| Mitsubishi | 261 | 307 | 271 | 249 | 296 | 264 | -12 | -11 | -7 |
| Nissan | 263 | 337 | 285 | 259 | 324 | 280 | -4 | -13 | -5 |
| Porsche | 332 | 422 | 374 | 314 | 410 | 363 | -18 | -12 | -12 |
| Subaru | 260 | 309 | 291 | 251 | 299 | 281 | -9 | -10 | -10 |
| Suzuki | 251 | 325 | 267 | 243 | 296 | 249 | -8 | -29 | -18 |
| Tesla | 304 | | 304 | 296 | | 296 | -8 | | -8 |
| Toyota | 264 | 342 | 295 | 257 | 329 | 289 | -7 | -13 | -6 |
| Volkswagen | 263 | 327 | 271 | 257 | 317 | 264 | -6 | -10 | -7 |
| Volvo | 272 | 325 | 288 | 264 | 316 | 288 | -8 | -9 | 0 |
| Fleet Total | 267 | 348 | 299 | 261 | 339 | 292 | -6 | -9 | -7 |

Overall, the standards decreased by 7 grams/mile from 2012 to 2013, an increase in stringency driven by the more stringent target curves for the 2013 model year. However, the target curves represent only one of several key factors that influence the standards. While increased stringency overall from one year to the next is expected because of the structure of the target curves, there are other contributing factors that can result in – and explain – occasional exceptions that may occur. For example, Table 3-23 shows that the standard for Ford cars remained steady from 2012 to 2013, a phenomenon that is based on an increase in the average footprint of Ford cars in the 2013 model year, as seen in Table 3-24.

Of the 22 manufacturers in the program in 2012 and 2013, fleet average footprint increased for seven, decreased for 12, and was unchanged for three. Increases in footprint ranged from 0.1 square feet for several manufacturers to 2.5 square feet for Ford (driven in part by Ford's

increase in truck share in 2013). The average footprint for the overall fleet increased by 0.3 square feet from 2012 to 2013. Note that an increase in footprint does not necessarily indicate that manufacturers built larger vehicles in 2013; because the footprint is weighted by production volume, an increase could also occur with no change to the fleet but as a result of increased consumer demand for larger vehicles. Thus an increase in footprint could be a result of either of these factors independently, or a mix of both factors.

Table 3-24. Average Footprint by Manufacturer and Fleet (square feet)

| Manufacturer | 2012 Model Year | | | 2013 Model Year | | | Change: 2012 to 2013 | | |
|--------------------|-----------------|-------------|-------------|-----------------|-------------|-------------|----------------------|------------|------------|
| | Cars | Trucks | All | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | | | | 45.2 | | 45.2 | | | |
| BMW | 45.9 | 51.4 | 47.3 | 46.2 | 50.8 | 47.4 | 0.3 | (0.6) | 0.1 |
| BYD Motors | 47.9 | | 47.9 | 47.9 | | 47.9 | | | |
| Coda | 41.5 | | 41.5 | 41.5 | | 41.5 | 0.0 | | 0.0 |
| Ferrari | 47.8 | | 47.8 | 47.1 | | 47.1 | (0.7) | | (0.7) |
| Fiat Chrysler | 47.2 | 53.6 | 51.4 | 47.6 | 54.5 | 51.5 | 0.4 | 0.9 | 0.1 |
| Fisker | 58.1 | | 58.1 | | | | | | |
| Ford | 45.3 | 59.4 | 50.9 | 47.0 | 59.5 | 53.4 | 1.7 | 0.1 | 2.5 |
| GM | 46.9 | 60.1 | 52.0 | 46.5 | 60.4 | 51.9 | (0.4) | 0.3 | (0.1) |
| Honda | 45.0 | 50.5 | 46.8 | 44.9 | 49.3 | 46.3 | (0.1) | (1.2) | (0.5) |
| Hyundai | 46.4 | 46.4 | 46.4 | 46.1 | 47.0 | 46.2 | (0.3) | 0.6 | (0.2) |
| Jaguar Land Rover | 51.0 | 48.4 | 49.0 | 50.8 | 48.2 | 48.8 | (0.2) | (0.2) | (0.2) |
| Kia | 45.6 | 51.9 | 46.2 | 45.4 | 45.6 | 45.4 | (0.2) | (6.3) | (0.8) |
| Lotus | | | | 47.1 | | 47.1 | | | |
| Mazda | 43.9 | 48.1 | 44.9 | 43.6 | 47.0 | 44.4 | (0.3) | (1.1) | (0.5) |
| McLaren | | | | 46.6 | | 46.6 | | | |
| Mercedes | 46.5 | 51.9 | 48.2 | 45.4 | 51.5 | 47.3 | (1.1) | (0.4) | (0.9) |
| Mitsubishi | 44.5 | 44.0 | 44.4 | 43.6 | 43.9 | 43.7 | (0.9) | (0.1) | (0.7) |
| Nissan | 45.0 | 51.6 | 46.8 | 45.8 | 50.8 | 47.2 | 0.8 | (0.8) | 0.4 |
| Porsche | 44.7 | 51.8 | 47.7 | 43.7 | 51.9 | 47.6 | (1.0) | 0.1 | (0.1) |
| Subaru | 44.3 | 44.7 | 44.5 | 44.0 | 44.6 | 44.4 | (0.3) | (0.1) | (0.1) |
| Suzuki | 42.1 | 48.7 | 43.4 | 41.8 | 44.0 | 42.0 | (0.3) | (4.7) | (1.4) |
| Tesla | 53.6 | | 53.6 | 53.6 | | 53.6 | 0.0 | | 0.0 |
| Toyota | 45.0 | 53.4 | 48.0 | 45.1 | 52.5 | 48.1 | 0.1 | (0.9) | 0.1 |
| Volkswagen | 45.0 | 49.0 | 45.5 | 45.2 | 49.0 | 45.6 | 0.2 | 0.0 | 0.1 |
| Volvo | 46.8 | 48.6 | 47.3 | 46.8 | 49.0 | 47.7 | 0.0 | 0.4 | 0.4 |
| Fleet Total | 45.7 | 54.5 | 48.8 | 45.9 | 54.8 | 49.1 | 0.2 | 0.3 | 0.3 |

I. Overall Compliance Summary

Final compliance for the 2012 and 2013 model years is summarized in Table 3-25 for the overall model year fleet, and separately for cars and trucks in Tables 3-26 and 3-27, respectively. As in the tables in Section 3.G, these show how the 2-cycle tailpipe values and the credit are used to “build” the overall compliance value, which is then compared to the model year standards described in Section 3.H. Overall, manufacturers outperformed the 2013 standard by 12 grams/mile, slightly better but comparable to their compliance margin in 2012 of 11 grams/mile.⁴⁴ In both the 2012 and 2013 model years, however, the industry’s over-compliance was entirely driven by the 18-20 grams/mile compliance margin seen in the car fleet, since the truck compliance values essentially equaled the overall fleet standards.

Table 3-25. Compliance & Credit Summary, 2012-2013 Model Years - Combined Cars and Trucks (g/mi)*

| Model Year | 2-Cycle Tailpipe | Credits | | | | CH ₄ & N ₂ O Deficit | Compliance Value | Standard |
|------------|------------------|---------|-------|-----|-----------|--|------------------|----------|
| | | FFV | TLAAS | A/C | Off-Cycle | | | |
| 2012 | 302 | 8 | 1 | 6 | 0 | 0 | 288 | 299 |
| 2013 | 294 | 8 | 1 | 7 | 0 | 0 | 279 | 292 |

*Values stated in this table and in the text are correct, although rounding of values may result in some apparent differences.

Table 3-26. Compliance & Credit Summary, 2012-2013 Model Years – Passenger Cars (g/mi)*

| Model Year | 2-Cycle Tailpipe | Credits | | | | CH ₄ & N ₂ O Deficit | Compliance Value | Standard |
|------------|------------------|---------|-------|-----|-----------|--|------------------|----------|
| | | FFV | TLAAS | A/C | Off-Cycle | | | |
| 2012 | 259 | 4 | 0 | 6 | 0 | 0 | 249 | 267 |
| 2013 | 251 | 4 | 0 | 7 | 0 | 0 | 241 | 261 |

*Values stated in this table and in the text are correct, although rounding of values may result in some apparent differences.

⁴⁴ Note that the rounded values in the tables may produce values that differ from those in the text as a result of rounding. For example, the correct difference between the 2013 standard and compliance value is 12 grams/mile, although the rounded values in the table would produce a difference of 13 grams/mile.

Table 3-27. Compliance & Credit Summary, 2012-2013 Model Years – Light Trucks (g/mi)*

| Model Year | 2-Cycle Tailpipe | Credits | | | | CH ₄ & N ₂ O Deficit | Compliance Value | Standard |
|------------|------------------|---------|-------|-----|-----------|--|------------------|----------|
| | | FFV | TLAAS | A/C | Off-Cycle | | | |
| 2012 | 369 | 14 | 1 | 8 | 0 | 0 | 348 | 348 |
| 2013 | 360 | 14 | 1 | 8 | 0 | 0 | 339 | 339 |

*Values stated in this table and in the text are correct, although rounding of values may result in some apparent differences.

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

A comparison between compliance values and target values for each manufacturer and fleet is shown in Table 3-28. The final row shows values for the total 2013 fleet. The comparison of the compliance and target values in Table 3-28, shown in the “Net Compliance” columns, indicates whether a manufacturer generated net credits or deficits in the 2013 model year. Negative values indicate over-compliance with the standards, or compliance values that are lower than the targets by the stated value. Positive values are thus an indication of compliance values that exceed (i.e., do not comply with) the applicable standards. Fiat Chrysler, for example, generated a 2013 model year deficit because their overall compliance value of 316 grams/mile is above their fleet-wide target of 311 grams/mile. Ford, on the other hand, reported net credits based on a compliance value of 299 grams/mile, 16 grams/mile lower than the fleet-wide target. Note, however, that the generation of a net deficit in the 2013 model by any manufacturer does not necessarily indicate that the manufacturer has failed to comply with the 2013 model year standards. Fiat Chrysler, for example, will be able to offset their 2013 deficit by using credits generated in previous model years, thereby complying with the 2013 standards.⁴⁵ The final row of Table 3-28 shows the conclusion that manufacturers over-complied with the 2013 model year standards by 12 grams/mile. The table also shows that the vast majority of this over-compliance came from passenger cars, with light trucks overall beating the standard by one gram/mile. A comparison of the values in the three previous tables to EPA projections for these values is in Appendix A.

⁴⁵ This section deals only with manufacturer performance within a model year, and does not consider the implications on compliance of the use of credits or deficits from previous model years or of sold and purchased credits. See Section 5 for a discussion of the current compliance status of each manufacturer that considers all of these factors.

Table 3-28. 2013 Model Year Compliance Summary by Manufacturer and Fleet (g/mi)

| Manufacturer | Compliance Value | | | Target Value | | | Net Compliance | | |
|--------------------|------------------|------------|------------|--------------|------------|------------|----------------|-----------|------------|
| | Cars | Trucks | All | Cars | Trucks | All | Cars | Trucks | All |
| Aston Martin | 435 | | 435 | 321 | | 321 | 114 | | 114 |
| BMW | 263 | 335 | 283 | 263 | 324 | 280 | 0 | 11 | 3 |
| BYD Motors | 0 | | 0 | 269 | | 269 | -269 | | -269 |
| Coda | 0 | | 0 | 239 | | 239 | -239 | | -239 |
| Ferrari | 465 | | 465 | 331 | | 331 | 134 | | 134 |
| Fiat Chrysler | 268 | 348 | 316 | 270 | 338 | 311 | -3 | 10 | 5 |
| Ford | 240 | 348 | 299 | 265 | 355 | 315 | -25 | -7 | -15 |
| GM | 254 | 364 | 301 | 263 | 360 | 304 | -9 | 4 | -4 |
| Honda | 225 | 307 | 254 | 256 | 318 | 278 | -31 | -11 | -24 |
| Hyundai | 233 | 310 | 236 | 261 | 309 | 263 | -28 | 1 | -27 |
| Jaguar Land Rover | 337 | 405 | 390 | 324 | 362 | 353 | 13 | 43 | 36 |
| Kia | 247 | 292 | 248 | 258 | 303 | 259 | -11 | -11 | -11 |
| Lotus | 334 | | 334 | 311 | | 311 | 23 | | 23 |
| Mazda | 232 | 296 | 251 | 250 | 311 | 268 | -18 | -15 | -17 |
| McLaren | 374 | | 374 | 329 | | 329 | 45 | | 45 |
| Mercedes | 275 | 347 | 299 | 262 | 354 | 292 | 13 | -7 | 6 |
| Mitsubishi | 254 | 267 | 258 | 249 | 296 | 264 | 5 | -29 | -6 |
| Nissan | 228 | 328 | 260 | 259 | 324 | 280 | -31 | 4 | -20 |
| Porsche | 309 | 363 | 336 | 314 | 410 | 363 | -5 | -47 | -26 |
| Subaru | 254 | 270 | 264 | 251 | 299 | 281 | 3 | -29 | -17 |
| Suzuki | 266 | 330 | 273 | 243 | 296 | 249 | 23 | 34 | 24 |
| Tesla | -6 | | -6 | 296 | | 296 | -302 | | -302 |
| Toyota | 217 | 332 | 268 | 257 | 329 | 289 | -40 | 3 | -21 |
| Volkswagen | 260 | 303 | 266 | 257 | 317 | 264 | 3 | -15 | 1 |
| Volvo | 282 | 337 | 308 | 264 | 316 | 288 | 18 | 21 | 20 |
| Fleet Total | 241 | 339 | 279 | 261 | 339 | 292 | -20 | -1 | -12 |

4. CREDIT TRANSACTIONS

Credits may be traded among manufacturers with a great deal of flexibility (with the exception of 2009 model year credits and credits generated by manufacturers using the TLAAS program, which are restricted to use only within a manufacturer's own fleets). There are only a few regulatory requirements that relate to credit transactions between manufacturers (other than the restrictions just noted), and these are generally designed to protect those involved in these transactions. While it may seem obvious, it is worth stating that a manufacturer may not trade credits that it does not have. Credits that are available for trade are only those available (1) at the conclusion of a model year when all the data is available with which to calculate the number of credits generated by a manufacturer, and not before; and (2) after a manufacturer has offset any deficits they might have. Credit transactions that result in a negative credit balance for the selling manufacturer are not allowed and can result in severe punitive actions. Although a third party may facilitate transactions, EPA's regulations allow only the automobile manufacturers to engage in credit transactions and hold credits.

Since the 1990's, many of EPA's vehicle emissions regulatory programs have included the flexibilities of averaging, banking, and trading (ABT). The incorporation of ABT provisions in EPA emissions regulations has been generally supported by a wide range of stakeholders: by manufacturers for the increased flexibility that ABT offers and by environmental groups because ABT enhances EPA's ability to introduce standards of greater stringency in an earlier time frame than might otherwise be achieved. Historically manufacturers tended to make use of the ability to average emissions and bank emissions credits for use in subsequent years, but until now there has been almost no credit trading activity between companies. The use of trading provisions in EPA's light-duty GHG program is an historic development, and one that EPA welcomes because we believe it will allow greater GHG reductions, lower compliance costs, and greater consumer choice.

The credit transactions reported by manufacturers through the 2013 model year are shown in Table 4-1.⁴⁶ As of the close of the 2013 model year, just over 2.5 million Megagrams of CO₂ credits had changed hands. Credit distributions are shown as negative values, in that a disbursement represents a deduction of credits of the specified model year for the selling manufacturer. Credit acquisitions are indicated as positive values because acquiring credits represents an increase in credits for the purchasing manufacturer. The model year represents the "vintage" of the credits that were sold, i.e., the model year from which the credits originated. The vintage always travels with the credits, regardless of when a transaction takes place and in what model year the credits are ultimately used. A manufacturer with 2010 model year credits can hold them until 2021, meaning, for example, that a sale of 2010 credits could potentially be reported to EPA as late as the reporting deadline for the 2021 model year, and those 2010 credits could be used by the buyer to offset deficits from the 2018-2021 model years. The overall impact of these credit transactions on the compliance position of each manufacturer is discussed in

⁴⁶ There may be additional credit transactions that have occurred, or that are expected to occur, but because of the timing of those transactions (after the manufacturers submitted their 2013 model year data) those transactions will be reported in the 2014 model year reports of the manufacturers involved, and thus will be included in EPA's performance report regarding the 2014 model year.

Section 5, which pulls together all the credits and deficits, including early credits, discussed in the preceding sections. Note that each value in the table is simply an indication of the quantity of credits from a given model year that has been acquired or disbursed by a manufacturer, and thus may represent multiple transactions with multiple buyers or sellers.

Table 4-1. Reported Credit Sales and Purchases as of the 2013 Model Year (Mg)

| | Manufacturer | Model Year “Vintage” | | | | Total |
|--------------------------|---------------|----------------------|-----------|-----------|-------------|-------------|
| | | 2010 | 2011 | 2012 | 2013 | |
| Credits Disbursed | Honda | (434,383) | | | | (434,383) |
| | Nissan | (200,000) | (500,000) | (250,000) | | (950,000) |
| | Tesla | (35,580) | (14,192) | (177,941) | (1,048,689) | (1,276,402) |
| Credits Acquired | Fiat Chrysler | 144,383 | 500,000 | | 1,048,689 | 1,693,072 |
| | Ferrari | 90,000 | | | | 90,000 |
| | Mercedes | 435,580 | 14,192 | 427,941 | | 877,713 |

5. COMPLIANCE STATUS AFTER THE 2013 MODEL YEAR

The vast majority of manufacturers have successfully demonstrated compliance with the 2012 and 2013 model year standards and are carrying a positive credit balance into the 2014 model year. The manufacturers that are in compliance with both model years represent more than 99 percent of total U.S. car and light truck sales in these first two model years of EPA's GHG standards. Table 5-1 shows one view of the accumulated credits for each manufacturer. Each manufacturer with a positive balance in the final column is, by definition, in compliance with the 2012 and 2013 model years (because all deficits must be offset before carrying credits forward).

Table 5-1 shows the total credits (or deficits) for each manufacturer in the last column. Table 5-1 also shows the credits (or deficits) generated by each manufacturer in the 2009-2013 model years, as well as the net impact of credit transactions on each manufacturer's credit balance. However, to fully understand the current compliance position of each manufacturer, we also need to know the makeup of the credit balance in terms of the origin, or vintage, of the credits. Knowing the vintage is important both for credits and deficits, because we need to know when credits expire and must be forfeited, and we need to know when a manufacturer is in violation of the regulations as a result of failing to offset a deficit within the required time frame.

Ferrari, as shown in Table 5-1, is a relatively simple example. They purchased 90,000 Mg of 2010 credits (we know the vintage from Section 4). These credits were more than sufficient to offset their 2012 deficit of 40,983 Mg. Because Ferrari generated a deficit in 2012 that they subsequently erased with purchased credits, Ferrari has complied with the 2012 standards. Ferrari then was able to carry 49,017 Mg of credits remaining from their purchase of 90,000 into the 2013 model year. Those credits were subsequently applied to their 2013 deficit, but were not sufficient to wholly offset the 2013 deficit, leaving Ferrari with an unresolved 2013 deficit of 653 Mg. Table 5-1 does not show the movement of credits between fleets and model years, thus Ferrari is shown with a 2012 deficit, and there is no indication of the vintage of the small deficit that they are carrying into the 2014 model year.

Table 5-1. Cumulative Credit Status After The 2013 Model Year (Mg)

| Manufacturer | Early Credits (2009-2011) | | 2012 | | 2013 | | Total Carried Forward to 2014 |
|--------------------|---------------------------|----------------|-------------------|----------------|-------------------|----------------------------|-------------------------------|
| | Earned | Bought or Sold | Earned | Bought or Sold | Earned | Bought, Sold, or Forfeited | |
| Toyota | 80,435,498 | - | 13,163,009 | - | 9,885,788 | - | 103,484,295 |
| Honda | 35,515,108 | (434,383) | 7,851,251 | - | 7,302,584 | - | 50,234,560 |
| GM | 24,564,829 | - | 2,872,354 | - | 1,748,357 | - | 29,185,540 |
| Ford | 16,075,888 | - | 4,641,001 | - | 7,829,549 | - | 28,546,438 |
| Hyundai | 14,007,495 | - | 3,566,721 | - | 5,782,163 | (169,775)* | 23,186,604 |
| Nissan | 18,131,200 | (700,000) | (729,937) | (250,000) | 5,190,521 | - | 21,641,784 |
| Kia | 10,444,192 | - | 1,343,373 | - | 1,352,888 | (123,956)* | 13,016,497 |
| Subaru | 5,755,171 | - | 543,316 | - | 1,298,850 | - | 7,597,337 |
| Fiat Chrysler | 9,110,207 | 644,383 | (1,892,184) | - | (1,631,285) | 1,048,689 | 7,279,810 |
| Mazda | 5,482,642 | - | 734,887 | - | 786,431 | - | 7,003,960 |
| Volkswagen | 6,441,405 | - | (502,495) | - | (148,949) | - | 5,789,961 |
| Mitsubishi | 1,449,336 | - | 57,837 | - | 58,209 | - | 1,565,382 |
| Suzuki | 876,650 | - | (127,699) | - | (55,398) | - | 693,553 |
| BMW | 1,004,292 | - | (287,861) | - | (259,619) | - | 456,812 |
| Porsche | - | - | 198,348 | - | 228,091 | - | 426,439 |
| Volvo | 740,358 | - | (175,195) | - | (297,006) | - | 268,157 |
| Mercedes | 378,272 | 449,772 | (748,793) | 427,941 | (377,880) | - | 129,312 |
| Fisker | - | - | 46,694 | - | - | - | 46,694 |
| Coda | - | - | 5,524 | - | 1,727 | - | 7,251 |
| BYD Motors | - | - | 595 | - | 1,681 | - | 2,276 |
| Tesla | 49,772 | (49,772) | 178,517 | (177,941) | 1,049,384 | (1,048,689) | 1,271 |
| Ferrari | - | 90,000 | (40,983) | - | (49,670) | - | (653) |
| Lotus | - | - | - | - | (763) | - | (763) |
| McLaren | - | - | - | - | (3,620) | - | (3,620) |
| Aston Martin | 3,332 | - | - | - | (8,115) | - | (4,783) |
| Jaguar Land Rover | - | - | (424,032) | - | (503,111) | - | (927,143) |
| Fleet Total | 230,465,647 | | 30,274,248 | | 39,180,807 | (293,731) | 299,626,971 |

* Forfeited per the requirements of a federal Consent Decree. See Section I.D.4.

Because manufacturers accumulate car and truck credits separately, and because they are allowed to move credits around between cars and trucks, the situation can get far more complex than seen in the Ferrari example.⁴⁷ Consider this example, where a manufacturer generates 1500 Mg of car credits and a -500 Mg deficit in trucks in 2012, and where credits all have a 5-year lifespan:

| 2012 Credits | |
|--------------|-------------|
| Fleet | (Mg) |
| Cars | 1500 |
| Trucks | -500 |
| Total | 1000 |

The manufacturer must use the car credits to offset the truck deficit in this case, because there are no credits available from prior model years to use, and credits cannot be carried forward until deficits are addressed. Thus the manufacturer carries a balance of 1000 Mg of credits from 2012 into 2013. Then in this example let's assume that in 2013 they generate 1000 Mg of credits in the car fleet and a deficit of -1000 Mg in the truck fleet, as shown below:

| 2012 Credits | | 2013 Credits |
|--------------|-------------|--------------|
| Fleet | (Mg) | (Mg) |
| Cars | 1500 | 1000 |
| Trucks | -500 | -1000 |
| Total | 1000 | 0 |

Here, the manufacturer would have 1000 Mg of 2012 credits

There are multiple choices for a manufacturer faced with such a situation. As shown above, all deficits are adequately addressed within each model year, and a manufacturer could leave it at that. Doing so would mean carrying forward the 1000 Mg of credits remaining from 2012 into 2014. There is, however, a smarter – but not mandatory – option. Because the regulations allow car and truck credits and deficits to be managed as separate “bins,” and because newer credits are generally more valuable than older credits (because they last longer) it would be smarter for this manufacturer to use the 1000 Mg of credits from 2012 to offset the deficit of -1000 Mg in the 2013 truck fleet, as shown below:

| 2012 Credits | | 2013 Credits |
|--------------|-----------------|-----------------|
| Fleet | (Mg) | (Mg) |
| Cars | 1500 | 1000 |
| Trucks | -500 | -1000 |
| Total | 1000 | 1000 |

Here, the manufacturer would have 1000 Mg of 2013 credits

The bottom line remains the same (1000 Mg of credits are carried into 2014), except that in this case the credits carried forward have a vintage from the newer 2013 model year. Theoretically, a manufacturer could use any mix of 2012 and 2013 credits to offset the 2013 truck deficit, in which case the credits remaining to carry forward would be a mix of 2012 and 2013 credits. The value of a given vintage is based on its expiration date, and the expiration date of 2010-2016 model year credits in EPA's GHG program is fixed at the 2021 model year, meaning that for the

⁴⁷ Note that the regulations require that all credits and deficits within a vehicle class (passenger cars or light trucks) are aggregated before transfers between vehicle classes occur. See 40 CFR 86.1865-12(k)(5).

2010-2016 model years it is less important to treat credits in this way. Nevertheless, this “first in, first out” accounting method is being used to determine the makeup of credit balances held by manufacturers (unless a manufacturer expresses a preference for an alternative accounting). It is challenging to display all the credit transfers, transactions, and vintages in a single data table in an easily understandable manner. However, we can display the current state of each manufacturer and the vintage of all the credits currently held by each manufacturer.

Table 5-2 reveals the credit balances for each manufacturer, after adjusting for credit transactions and transfers, by the vintage of the credits held by the manufacturer. The model year column headings represent the vintages that make up the total credits (or deficit) being carried forward into the 2014 model year. This table shows, for example, the extent to which some manufacturers have used credits from prior model years. BMW, for example, generated almost 6 million Mg of early credits in the 2009 model year, and Table 5-2 makes it clear that all of those, and about half of their 2010 credits, have been used to offset deficits in the 2012 and 2013 model years. It also shows that there is only one manufacturer (Jaguar Land Rover) that has not yet complied with the 2012 standards and is thus carrying forward a deficit from 2012. All other manufacturers have a balance of zero or greater in 2012, thus all others have demonstrated compliance with the 2012 model year standards. In addition to Jaguar Land Rover, four other small manufacturers are carrying forward a deficit from the 2013 model year, and have thus not yet demonstrated compliance with the 2013 model year standards. None of the five manufacturers with deficits going into the 2014 model year are out of compliance with the program. A deficit from the 2012 model year can be carried forward for three years after the year in which it is generated, meaning that Jaguar Land Rover must reconcile their deficit by the time they report their 2015 model year results to EPA. Similarly, deficits from the 2013 model year do not have to be offset until the end of the 2016 model year.

Note that Tables 5-1 and 5-2 over-simplify the data with respect to the manufacturers using the TLAAS program in order to present the data concisely. Jaguar Land Rover and Mercedes have vehicles subject to the primary standards and subject to the less stringent TLAAS standards, yet for the purpose of these tables we have aggregated the credits accumulated in both the primary and TLAAS fleets into a single row in the table. Although they are not separated for the purposes of these tables, EPA maintains careful records (as do the manufacturers) of the credits within the Primary and TLAAS programs, as is necessary because of the different treatment and restrictions for the different fleets. The data we are making available online and in this report will identify the source of each credit (e.g., whether from the Primary or TLAAS fleets).

Table 5-2. Credits Available After the 2013 Model Year, Reflecting Trades & Transfers (Mg)

| Manufacturer | 2009* | 2010 | 2011 | 2012 | 2013 | Total Carried Forward to 2014 |
|----------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--|
| Toyota | 30,658,662 | 34,457,797 | 14,651,963 | 13,163,009 | 10,552,864 | 103,484,295 |
| Honda | 14,073,890 | 13,635,907 | 7,370,928 | 7,851,251 | 7,302,584 | 50,234,560 |
| GM | 6,473,623 | 11,073,134 | 6,184,049 | 2,872,354 | 2,582,380 | 29,185,540 |
| Ford | 5,882,011 | 7,416,966 | 2,776,911 | 4,641,001 | 7,829,549 | 28,546,438 |
| Hyundai | 4,601,633 | 5,388,593 | 4,012,969 | 3,566,721 | 5,616,688 | 23,186,604 |
| Nissan | 8,207,077 | 5,581,739 | 1,352,749 | 989,226 | 5,510,993 | 21,641,784 |
| Kia | 3,134,775 | 2,651,872 | 4,657,545 | 1,343,373 | 1,228,932 | 13,016,497 |
| Subaru | 568,109 | 2,225,296 | 2,876,413 | 543,316 | 1,384,203 | 7,597,337 |
| Fiat Chrysler | - | 3,308,200 | 2,605,453 | - | 1,366,157 | 7,279,810 |
| Mazda | 1,340,917 | 3,201,708 | 925,179 | 749,725 | 786,431 | 7,003,960 |
| Volkswagen | 1,150,976 | 2,811,663 | 1,528,432 | 74,076 | 224,814 | 5,789,961 |
| Mitsubishi | 583,146 | 521,776 | 302,394 | 67,976 | 90,090 | 1,565,382 |
| Suzuki | 265,311 | 329,382 | 98,860 | - | - | 693,553 |
| BMW | - | 141,255 | 315,557 | - | - | 456,812 |
| Porsche | | | | 198,348 | 228,091 | 426,439 |
| Volvo | - | - | 268,157 | - | - | 268,157 |
| Mercedes | | | | 103,557 | 25,755 | 129,312 |
| Fisker | | | | 46,694 | | 46,694 |
| Coda | | | | 5,524 | 1,727 | 7,251 |
| BYD Motors | | | | 595 | 1,681 | 2,276 |
| Tesla | | | | 576 | 695 | 1,271 |
| Ferrari | | | | | (653) | (653) |
| Lotus | | | | | (763) | (763) |
| McLaren | | | | | (3,620) | (3,620) |
| Aston Martin | | | | | (4,783) | (4,783) |
| Jaguar Land Rover | - | - | - | (424,032) | (503,111) | (927,143) |
| Fleet Total | 76,940,130 | 92,745,288 | 49,927,559 | 35,793,290 | 44,220,704 | 299,626,971 |

*2009 model year credits may not be traded to another manufacturer. They are also unavailable for use after the 2014 model year.

APPENDIX A: COMPARING ACTUAL PERFORMANCE TO RULEMAKING PROJECTIONS

As described in Section 1, EPA's GHG program was promulgated in two regulatory actions conducted jointly with NHTSA. The first rulemaking established standards for the 2012-2016 model years, and the second rulemaking set standards for the 2017 and later model years.^{48 49} In each of these rulemakings we included tables summarizing our projections of what the fleet-wide standards would be and how we expected manufacturers would comply with the standards. When evaluating these projections and how they compare to the actual performance as described in this report, consider that the projections for the 2012-2016 model years were finalized in early 2010, and the 2017 and later projections were determined in the middle of 2012. The projections were made with the best available information at the time, but it should not be surprising that actual performance differs from the rulemaking projections. Factors such as consumer preferences, technology innovation, fuel prices, and manufacturer behavior can change in unanticipated ways, leading current, actual performance to diverge from projections made in the past. While a comparison of actual performance to projections is interesting, and helps illuminate whether or not the program is achieving its expected benefits, this is secondary in the context of this report, which is focused on actual compliance. Compliance of manufacturers with EPA's standards is not determined by comparing current model year results to past projections, but is instead determined by comparing achieved compliance values to the regulatory footprint-based standards covered in Sections 1-5 of this report.

Table A-1 shows key projected values for the combined car and truck fleet for the 2012-2025 model years. All of the values in this table (and Tables A-2 and A-3) come directly from the regulatory actions noted above. Note that we projected that the industry, on average, would comply exactly with the target, i.e., the compliance value equals the target value in each model year. This table illustrates a fundamental principle: EPA projections from the rulemaking analysis assumed manufacturers would achieve significant GHG emission reductions (and hence compliance) through a variety of technologies. In the early years, until the incentive is phased out in the 2016 model year, we projected significant production of flexible fuel vehicles (FFV). We also projected relatively high production of reduced GHG air conditioning systems across the fleet, resulting in reductions ranging from 3.5 grams/mile in 2012 and increasing to over 20 grams/mile late in the program. As shown in Table A-1, we projected that manufacturers would start with a 2-cycle tailpipe value of 298 grams/mile in the 2013 model year, reducing that by total credits and incentives of about 12 grams/mile, thus yielding a net compliance value of 286 grams/mile. We did not make any estimations of the use of N₂O and CH₄ alternative standards for two reasons: (1) the overall impact was expected to be very small, and (2) manufacturers are required to offset deficits accumulated with CO₂-equivalent credits as a result of using this flexibility, thus there is no net impact on the program.

⁴⁸ Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Proposed Rule, Federal Register 74 (28 September 2009): 49454-49789.

⁴⁹ 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 77 (15 October 2012): 62889.

Tables A-2 and A-3 show the same projected values as Table A-1, but separately for cars and trucks, respectively. In the regulatory action establishing the standards we did not publish car- and truck-specific estimated values for the 2-cycle tailpipe emissions or the use of credits and incentives in the 2012-2015 model years, thus these values are shown as N/A in these tables.

Table A-1. Projected CO₂ Performance in Rulemaking Analyses for Combined Passenger Car and Light Truck Fleet (g/mi)

| Model Year | 2-Cycle Tailpipe Emissions | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N₂O & CH₄ Deficit | Compliance | Target |
|-------------------|-----------------------------------|-------------------|-------------------|---------------------|-------------------------|--|-------------------|---------------|
| 2012 | 307 | 6.5 | 3.5 | 1.2 | 0.0 | N/A | 295 | 295 |
| 2013 | 298 | 5.8 | 5.0 | 0.9 | 0.0 | N/A | 286 | 286 |
| 2014 | 290 | 5.0 | 7.5 | 0.6 | 0.0 | N/A | 276 | 276 |
| 2015 | 277 | 3.7 | 10.0 | 0.3 | 0.0 | N/A | 263 | 263 |
| 2016 | 261 | 0.0 | 10.6 | 0.1 | 0.5 | N/A | 250 | 250 |
| 2017 | 256 | 0.0 | 12.5 | 0.0 | 0.6 | N/A | 243 | 243 |
| 2018 | 249 | 0.0 | 14.9 | 0.0 | 0.8 | N/A | 234 | 234 |
| 2019 | 242 | 0.0 | 17.5 | 0.0 | 0.9 | N/A | 223 | 223 |
| 2020 | 234 | 0.0 | 19.2 | 0.0 | 1.0 | N/A | 214 | 214 |
| 2021 | 222 | 0.0 | 20.8 | 0.0 | 1.1 | N/A | 200 | 200 |
| 2022 | 212 | 0.0 | 20.8 | 0.0 | 1.4 | N/A | 190 | 190 |
| 2023 | 203 | 0.0 | 20.8 | 0.0 | 1.7 | N/A | 181 | 181 |
| 2024 | 194 | 0.0 | 20.6 | 0.0 | 1.9 | N/A | 172 | 172 |
| 2025 | 186 | 0.0 | 20.6 | 0.0 | 2.3 | N/A | 163 | 163 |

Table A-2. Projected CO₂ Performance in Rulemaking Analyses for Passenger Cars (g/mi)

| Model Year | 2-Cycle Tailpipe Emissions | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target |
|------------|----------------------------|------------|------------|--------------|------------------|--|------------|--------|
| 2012 | N/A | N/A | N/A | N/A | N/A | N/A | 263 | 263 |
| 2013 | N/A | N/A | N/A | N/A | N/A | N/A | 256 | 256 |
| 2014 | N/A | N/A | N/A | N/A | N/A | N/A | 247 | 247 |
| 2015 | N/A | N/A | N/A | N/A | N/A | N/A | 236 | 236 |
| 2016 | 235 | 0.0 | 10.2 | 0.0 | 0.4 | N/A | 225 | 225 |
| 2017 | 226 | 0.0 | 12.8 | 0.0 | 0.5 | N/A | 213 | 213 |
| 2018 | 218 | 0.0 | 14.3 | 0.0 | 0.6 | N/A | 203 | 203 |
| 2019 | 210 | 0.0 | 15.8 | 0.0 | 0.7 | N/A | 193 | 193 |
| 2020 | 201 | 0.0 | 17.3 | 0.0 | 0.8 | N/A | 183 | 183 |
| 2021 | 193 | 0.0 | 18.8 | 0.0 | 0.8 | N/A | 173 | 173 |
| 2022 | 184 | 0.0 | 18.8 | 0.0 | 0.9 | N/A | 164 | 164 |
| 2023 | 177 | 0.0 | 18.8 | 0.0 | 1.0 | N/A | 157 | 157 |
| 2024 | 170 | 0.0 | 18.8 | 0.0 | 1.1 | N/A | 150 | 150 |
| 2025 | 163 | 0.0 | 18.8 | 0.0 | 1.4 | N/A | 143 | 143 |

Table A-3. Projected CO₂ Performance in Rulemaking Analyses for Light Trucks (g/mi)

| Model Year | 2-Cycle Tailpipe Emissions | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target |
|------------|----------------------------|------------|------------|--------------|------------------|--|------------|--------|
| 2012 | N/A | N/A | N/A | N/A | N/A | N/A | 346 | 346 |
| 2013 | N/A | N/A | N/A | N/A | N/A | N/A | 337 | 337 |
| 2014 | N/A | N/A | N/A | N/A | N/A | N/A | 326 | 326 |
| 2015 | N/A | N/A | N/A | N/A | N/A | N/A | 312 | 312 |
| 2016 | 310 | 0.0 | 11.4 | 0.0 | 0.7 | N/A | 298 | 298 |
| 2017 | 308 | 0.0 | 12.0 | 0.0 | 0.9 | N/A | 295 | 295 |
| 2018 | 304 | 0.0 | 16.0 | 0.0 | 1.0 | N/A | 287 | 287 |
| 2019 | 299 | 0.0 | 20.6 | 0.0 | 1.2 | N/A | 278 | 278 |
| 2020 | 294 | 0.0 | 22.5 | 0.0 | 1.4 | N/A | 270 | 270 |
| 2021 | 276 | 0.0 | 24.4 | 0.0 | 1.5 | N/A | 250 | 250 |
| 2022 | 264 | 0.0 | 24.4 | 0.0 | 2.2 | N/A | 238 | 238 |
| 2023 | 253 | 0.0 | 24.4 | 0.0 | 2.9 | N/A | 226 | 226 |
| 2024 | 242 | 0.0 | 24.4 | 0.0 | 3.6 | N/A | 214 | 214 |
| 2025 | 233 | 0.0 | 24.4 | 0.0 | 4.3 | N/A | 204 | 204 |

Table A-4 shows a comparison of the projected values (in Tables A-1, A-2, and A-3) with the actual performance for the 2012 and 2013 model years for the combined car and truck fleet. As is the case throughout this report, values for the combined fleet of cars and trucks are calculated as a weighted average of the individual car and truck fleet values. However, the methodology used for weighting and combining car and truck values in this section differs from the methodology used elsewhere in this report. As noted in Section 1, the general methodology used in this report to create a complete fleet value from separate car and truck fleet values incorporates weighting by the relative lifetime vehicle miles traveled (VMT) of cars and trucks (lifetime VMT values for cars and trucks are specified in the regulations as 195,264 and 225,865 miles, respectively). Because credits are calculated based on differing car and truck VMT values, the methodology for combining car and truck grams/mile values must include weighting by VMT for the result to be internally and mathematically consistent with the total Megagrams of credits generated by the fleet. However, past rulemaking projections for the combined car and truck fleet were determined by weighting car and truck fleet values by their relative production only, ignoring the impact of VMT. In order to provide an accurate comparison, the actual performance values in Table A-4 are calculated in the same manner as the projected values: without weighting by VMT. For this reason the actual values in Table A-4 are not the same as values with the same labels presented elsewhere in this report. For example, the 2012 model year 2-cycle tailpipe value in Table A-4 is 299 grams/mile, whereas the same metric is shown as 302 grams/mile in Table 3-1. Both of these values are correct, as the former is not VMT-weighted and the latter is VMT-weighted. It is only within this section that a different methodology is used, specifically to facilitate an apples-to-apples comparison between actual fleet performance and EPA's projections. Note that values for the car and truck fleets are identical to those shown elsewhere in the report; only the values for the combined fleet will differ based on the different methods of calculating combined values from the individual car and truck values.

Table A-4 shows that actual industry-wide compliance targets for the combined car and truck fleets are slightly higher than EPA's projections for both model year 2012 (by 1 gram/mile) and model year 2013 (by 3 grams/mile). This is because actual industry-wide footprint values are slightly higher than projected in the rulemaking analyses (for more information on footprint trends, see EPA's CO₂ and Fuel Economy Trends report at epa.gov/otaq/fetrends.htm).

More important, however, is that despite these slightly higher targets, actual industry-wide 2-cycle tailpipe emissions and overall compliance values are significantly lower than projected in the past EPA rulemaking analyses. Actual industry-wide 2-cycle tailpipe emissions performance was 8-9 grams/mile lower than the projected values in the 2012 and 2013 model years. Accounting for slightly higher flexible fuel vehicle and air conditioning credits and slightly lower TLAAS credits than projected, the actual industry-wide compliance values were 11 grams/mile lower in model year 2012 and 10 grams/mile lower in model year 2013, relative to the rulemaking projections. This means that, other things being equal (such as new vehicle sales and VMT), the aggregate CO₂ emissions reductions from the first two years of the program have been larger than projected by EPA in the rulemaking analyses. It also reinforces that the industry had a compliance "cushion" in these two years, and is earning credits that are being banked for possible future use.

Tables A-5 and A-6 provide comparative data separately for cars and trucks for the 2012 and 2013 model years (though projected values for use of credits by vehicle category are not available until model year 2016). For cars, the directional impacts are similar to those for the combined car and truck fleet, i.e., the actual targets are higher than projected and the actual compliance values are much lower (15 grams/mile in 2013). The actual targets are also higher than the projected targets for the truck fleet, but in this case the actual compliance values are slightly higher than projected (2 grams/mile in 2013).

Table A-4. Actual and Projected CO₂ Values, Cars and Trucks Combined (g/mi)

| Model Year | ACTUAL (COMBINED FLEET NOT VMT-WEIGHTED) | | | | | | | | PROJECTED | | | | | | | |
|------------|--|------------|------------|--------------|------------------|--|------------|--------|------------------|------------|------------|--------------|------------------|--|------------|--------|
| | 2-Cycle Tailpipe | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target | 2-Cycle Tailpipe | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target |
| 2012 | 298 | 7.7 | 6.4 | 0.6 | 0.0 | 0.2 | 284 | 296 | 307 | 6.5 | 3.5 | 1.2 | 0.0 | N/A | 295 | 295 |
| 2013 | 290 | 7.5 | 7.1 | 0.6 | 0.0 | 0.2 | 276 | 289 | 298 | 5.8 | 5.0 | 0.9 | 0.0 | N/A | 286 | 286 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

Table A-5. Actual and Projected CO₂ Values, Passenger Cars (g/mi)

| Model Year | ACTUAL | | | | | | | | PROJECTED | | | | | | | |
|------------|------------------|------------|------------|--------------|------------------|--|------------|--------|------------------|------------|------------|--------------|------------------|--|------------|--------|
| | 2-Cycle Tailpipe | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target | 2-Cycle Tailpipe | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target |
| 2012 | 259 | 4.0 | 5.7 | 0.3 | 0.0 | 0.1 | 249 | 267 | N/A | N/A | N/A | N/A | N/A | N/A | 263 | 263 |
| 2013 | 251 | 4.0 | 6.5 | 0.2 | 0.0 | 0.1 | 241 | 261 | N/A | N/A | N/A | N/A | N/A | N/A | 256 | 256 |

Table A-6. Actual and Projected CO₂ Values, Light Trucks (g/mi)

| Model Year | ACTUAL | | | | | | | | PROJECTED | | | | | | | |
|------------|------------------|------------|------------|--------------|------------------|--|------------|--------|------------------|------------|------------|--------------|------------------|--|------------|--------|
| | 2-Cycle Tailpipe | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target | 2-Cycle Tailpipe | FFV Credit | A/C Credit | TLAAS Credit | Off-Cycle Credit | N ₂ O & CH ₄ Deficit | Compliance | Target |
| 2012 | 369 | 14.5 | 7.5 | 1.2 | 0.0 | 0.3 | 348 | 348 | N/A | N/A | N/A | N/A | N/A | N/A | 346 | 346 |
| 2013 | 360 | 13.7 | 8.2 | 1.2 | 0.0 | 0.3 | 339 | 339 | N/A | N/A | N/A | N/A | N/A | N/A | 337 | 337 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

APPENDIX B: VEHICLE PRODUCTION VOLUMES & MARKET SHARE

Table B-1. Vehicle Production Volumes by Model Year

| Manufacturer | Model Year 2012 | | | Model Year 2013 | | |
|-----------------------------|------------------|------------------|-------------------|------------------|------------------|-------------------|
| | Car | Truck | All | Car | Truck | All |
| Aston Martin ^{A B} | n/a | n/a | n/a | 364 | 0 | 364 |
| BMW | 191,154 | 65,856 | 257,010 | 303,319 | 98,969 | 402,288 |
| BYD Motors ^B | 11 | 0 | 11 | 32 | 0 | 32 |
| Coda ^B | 115 | 0 | 115 | 37 | 0 | 37 |
| Ferrari ^B | 1,510 | 0 | 1,510 | 1,902 | 0 | 1,902 |
| Fiat Chrysler | 538,887 | 994,996 | 1,533,883 | 654,845 | 852,653 | 1,507,498 |
| Fisker ^{B C} | 1,415 | 0 | 1,415 | n/a | n/a | n/a |
| Ford | 1,052,721 | 701,602 | 1,754,323 | 1,166,975 | 1,234,018 | 2,400,993 |
| GM | 1,449,244 | 915,130 | 2,364,374 | 1,432,131 | 913,765 | 2,345,896 |
| Honda | 1,047,165 | 493,414 | 1,540,579 | 1,021,800 | 472,569 | 1,494,369 |
| Hyundai | 630,418 | 47,766 | 678,184 | 1,061,950 | 38,073 | 1,100,023 |
| Jaguar Land Rover | 12,769 | 41,792 | 54,561 | 16,051 | 47,532 | 63,583 |
| Kia | 439,191 | 48,612 | 487,803 | 611,414 | 16,980 | 628,394 |
| Lotus ^{A B} | n/a | n/a | n/a | 170 | 0 | 170 |
| Mazda | 213,308 | 65,696 | 279,004 | 164,862 | 61,093 | 225,955 |
| McLaren ^{A B} | 0 | 0 | 0 | 412 | 0 | 412 |
| Mercedes | 173,832 | 81,573 | 255,405 | 207,957 | 89,041 | 296,998 |
| Mitsubishi | 51,927 | 12,540 | 64,467 | 32,654 | 13,754 | 46,408 |
| Nissan | 896,278 | 331,886 | 1,228,164 | 919,647 | 372,970 | 1,292,617 |
| Porsche | 16,946 | 12,927 | 29,873 | 22,021 | 19,461 | 41,482 |
| Subaru | 106,152 | 163,860 | 270,012 | 145,705 | 211,326 | 357,031 |
| Suzuki | 25,266 | 5,997 | 31,263 | 10,427 | 1,116 | 11,543 |
| Tesla ^B | 2,952 | 0 | 2,952 | 17,813 | 0 | 17,813 |
| Toyota | 1,298,021 | 722,227 | 2,020,248 | 1,347,436 | 915,658 | 2,263,094 |
| Volkswagen | 500,690 | 64,882 | 565,572 | 559,448 | 68,414 | 627,862 |
| Volvo | 52,375 | 19,432 | 71,807 | 42,072 | 31,282 | 73,354 |
| All | 8,702,347 | 4,790,188 | 13,492,535 | 9,741,444 | 5,458,674 | 15,200,118 |

^A Exempt from compliance with 2012 model year standards. ^B Only manufactures cars. ^C Did not produce any 2013 model year vehicles.

Table B-2. Vehicle Category Market Share by Model Year

| Manufacturer | 2012 | | 2013 | |
|-----------------------------|------------|------------|------------|------------|
| | Car % | Truck % | Car % | Truck % |
| Aston Martin ^{A B} | | | 100% | 0% |
| BMW | 74% | 26% | 75% | 25% |
| BYD Motors ^B | 100% | 0% | 100% | 0% |
| Coda ^B | 35% | 65% | 43% | 57% |
| Ferrari ^B | 100% | 0% | 100% | 0% |
| Fiat Chrysler | 35% | 65% | 43% | 57% |
| Fisker ^{B C} | 100% | 0% | | |
| Ford | 60% | 40% | 49% | 51% |
| GM | 61% | 39% | 61% | 39% |
| Honda | 68% | 32% | 68% | 32% |
| Hyundai | 93% | 7% | 97% | 3% |
| Jaguar Land Rover | 23% | 77% | 25% | 75% |
| Kia | 90% | 10% | 97% | 3% |
| Lotus ^{A B} | | | 100% | 0% |
| Mazda | 76% | 24% | 73% | 27% |
| McLaren ^{A B} | | | 100% | 0% |
| Mercedes | 68% | 32% | 70% | 30% |
| Mitsubishi | 81% | 19% | 70% | 30% |
| Nissan | 73% | 27% | 71% | 29% |
| Porsche | 57% | 43% | 53% | 47% |
| Subaru | 39% | 61% | 41% | 59% |
| Suzuki | 81% | 19% | 90% | 10% |
| Tesla ^B | 100% | 0% | 100% | 0% |
| Toyota | 64% | 36% | 60% | 40% |
| Volkswagen | 89% | 11% | 89% | 11% |
| Volvo | 73% | 27% | 57% | 43% |
| All | 64% | 36% | 64% | 36% |

^A Exempt from compliance with 2012 model year standards. ^B Only manufactures cars. ^C Did not produce any 2013 model year vehicles.

APPENDIX C: 2012 MODEL YEAR COMPLIANCE VALUES

Table C-1. 2012 Compliance Values - Combined Passenger Car & Light Truck Fleet (g/mi)

| Manufacturer | 2-Cycle Tailpipe | Credits (g/mi) | | | | CH ₄ & N ₂ O Deficit | Compliance Value |
|--------------------|------------------|----------------|----------|----------|-----------|--|------------------|
| | | FFV | TLAAS | A/C | Off-Cycle | | |
| BMW | 302 | 0 | 0 | 8 | 0 | 0 | 294 |
| BYD Motors | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coda | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ferrari | 494 | 0 | 69 | 10 | 0 | 0 | 484 |
| Fiat Chrysler | 357 | 18 | 0 | 10 | 0 | 0 | 329 |
| Fisker | 146 | 0 | 0 | 0 | 0 | 0 | 146 |
| Ford | 315 | 14 | 0 | 6 | 0 | 1 | 295 |
| General Motors | 331 | 16 | 0 | 8 | 0 | 0 | 307 |
| Honda | 266 | 0 | 0 | 3 | 0 | 0 | 263 |
| Hyundai | 249 | 0 | 0 | 5 | 0 | 0 | 244 |
| Jaguar Land Rover | 426 | 0 | 66 | 7 | 0 | 0 | 419 |
| Kia | 266 | 0 | 0 | 5 | 0 | 0 | 260 |
| Mazda | 263 | 0 | 0 | 0 | 0 | 0 | 263 |
| Mercedes-Benz | 343 | 13 | 10 | 10 | 0 | 0 | 320 |
| Mitsubishi | 267 | 0 | 0 | 0 | 0 | 0 | 267 |
| Nissan | 295 | 4 | 0 | 3 | 0 | 0 | 288 |
| Porsche | 342 | 0 | 75 | 0 | 0 | 0 | 342 |
| Subaru | 282 | 0 | 0 | 0 | 0 | 0 | 282 |
| Suzuki | 287 | 0 | 0 | 0 | 0 | 0 | 287 |
| Tesla | 0 | 0 | 0 | 6 | 0 | 0 | -6 |
| Toyota | 273 | 4 | 0 | 7 | 0 | 0 | 263 |
| Volkswagen | 281 | 1 | 0 | 7 | 0 | 2 | 276 |
| Volvo | 311 | 0 | 0 | 11 | 0 | 0 | 300 |
| Fleet Total | 302 | 8 | 1 | 6 | 0 | 0 | 288 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

Table C-2. 2012 Compliance Values - Passenger Car Fleet (g/mi)

| Manufacturer | 2-Cycle Tailpipe | Credits (g/mi) | | | | CH ₄ & N ₂ O Deficit | Compliance Value |
|--------------------|------------------|----------------|----------|----------|-----------|--|------------------|
| | | FFV | TLAAS | A/C | Off-Cycle | | |
| BMW | 277 | 0 | 0 | 7 | 0 | 0 | 270 |
| BYD Motors | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coda | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ferrari | 494 | 0 | 69 | 10 | 0 | 0 | 484 |
| Fiat Chrysler | 300 | 13 | 0 | 9 | 0 | 0 | 278 |
| Fisker | 146 | 0 | 0 | 0 | 0 | 0 | 146 |
| Ford | 261 | 9 | 0 | 5 | 0 | 0 | 248 |
| General Motors | 283 | 11 | 0 | 8 | 0 | 0 | 264 |
| Honda | 237 | 0 | 0 | 3 | 0 | 0 | 234 |
| Hyundai | 243 | 0 | 0 | 4 | 0 | 0 | 239 |
| Jaguar Land Rover | 376 | 0 | 73 | 5 | 0 | 0 | 371 |
| Kia | 258 | 0 | 0 | 5 | 0 | 0 | 253 |
| Mazda | 241 | 0 | 0 | 0 | 0 | 0 | 241 |
| Mercedes-Benz | 316 | 11 | 4 | 9 | 0 | 0 | 295 |
| Mitsubishi | 262 | 0 | 0 | 0 | 0 | 0 | 262 |
| Nissan | 258 | 0 | 0 | 2 | 0 | 0 | 256 |
| Porsche | 325 | 0 | 66 | 0 | 0 | 0 | 325 |
| Subaru | 257 | 0 | 0 | 0 | 0 | 0 | 257 |
| Suzuki | 267 | 0 | 0 | 0 | 0 | 0 | 267 |
| Tesla | 0 | 0 | 0 | 6 | 0 | 0 | -6 |
| Toyota | 221 | 0 | 0 | 7 | 0 | 0 | 214 |
| Volkswagen | 274 | 1 | 0 | 6 | 0 | 2 | 269 |
| Volvo | 297 | 0 | 0 | 10 | 0 | 0 | 287 |
| Fleet Total | 259 | 4 | 0 | 6 | 0 | 0 | 249 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

Table C-3. 2012 Compliance Values - Light Truck Fleet (g/mi)

| Manufacturer | 2-Cycle Tailpipe | Credits (g/mi) | | | | CH ₄ & N ₂ O Deficit | Compliance Value |
|--------------------|------------------|----------------|----------|----------|-----------|--|------------------|
| | | FFV | TLAAS | A/C | Off-Cycle | | |
| BMW | 363 | 0 | 0 | 11 | 0 | 0 | 353 |
| Fiat Chrysler | 384 | 21 | 0 | 10 | 0 | 0 | 353 |
| Ford | 385 | 21 | 0 | 8 | 0 | 0 | 357 |
| General Motors | 397 | 23 | 0 | 8 | 0 | 0 | 366 |
| Honda | 320 | 0 | 0 | 4 | 0 | 0 | 316 |
| Hyundai | 312 | 0 | 0 | 7 | 0 | 0 | 305 |
| Jaguar Land Rover | 439 | 0 | 64 | 8 | 0 | 0 | 431 |
| Kia | 324 | 0 | 0 | 4 | 0 | 0 | 320 |
| Mazda | 324 | 0 | 0 | 0 | 0 | 0 | 324 |
| Mercedes-Benz | 393 | 15 | 22 | 11 | 0 | 0 | 367 |
| Mitsubishi | 283 | 0 | 0 | 0 | 0 | 0 | 283 |
| Nissan | 382 | 15 | 0 | 4 | 0 | 0 | 363 |
| Porsche | 362 | 0 | 84 | 0 | 0 | 0 | 362 |
| Subaru | 296 | 0 | 0 | 0 | 0 | 0 | 296 |
| Suzuki | 361 | 0 | 0 | 0 | 0 | 0 | 361 |
| Toyota | 354 | 9 | 0 | 6 | 0 | 0 | 339 |
| Volkswagen | 330 | 0 | 0 | 9 | 0 | 0 | 322 |
| Volvo | 343 | 0 | 0 | 12 | 0 | 0 | 331 |
| Fleet Total | 369 | 14 | 1 | 8 | 0 | 0 | 348 |

This table was updated on March 31, 2015 to correct errors limited to 2-cycle tailpipe CO₂ values for manufacturers using the Temporary Lead-time Allowance Alternative Standards (see Section 3.B).

APPENDIX D: 2013 MODEL YEAR REPORTED CREDITS AND DEFICITS

Table D-1. 2013 Model Year Reported Credits and Deficits

| Manufacturer | Pathway | Fleet | Credit Type | Fleet Average (g/mi) | Fleet Standard (g/mi) | Production Volume | Credits (Mg) |
|---------------|---------|-------|--------------------------|----------------------------|-----------------------------|----------------------|--------------|
| Aston Martin | TLAAS | Car | Fleet Average | 444 | 321 | 364 | -8,742 |
| | | | A/C Leakage | 0 | 0 | 364 | 243 |
| | | | A/C Efficiency | 0 | 0 | 364 | 384 |
| BMW | Primary | Car | Fleet Average | 271 | 263 | 303,319 | -473,818 |
| | | | A/C Leakage | 0 | 0 | 302,969 | 251,534 |
| | | | A/C Efficiency | 0 | 0 | 303,319 | 208,519 |
| | | Truck | Fleet Average | 346 | 324 | 98,969 | -491,780 |
| | | | A/C Leakage | 0 | 0 | 98,969 | 156,207 |
| | | | A/C Efficiency | 0 | 0 | 98,969 | 96,121 |
| | | | CH ₄ Deficit | 0 | 0 | 3,800 | -1287 |
| | | | N ₂ O Deficit | 0 | 0 | 3,800 | -5,115 |
| BYD Motors | Primary | Car | Fleet Average | 0 | 269 | 32 | 1,681 |
| | | | Advanced Technology | 0 | 0 | 32 | 0 |
| Coda | Primary | Car | Fleet Average | 0 | 239 | 37 | 1,727 |
| | | | Advanced Technology | 0 | 0 | 37 | 0 |
| Ferrari | TLAAS | Car | Fleet Average | 475 | 331 | 1,902 | -53,480 |
| | | | A/C Leakage | 0 | 0 | 1,902 | 2,422 |
| | | | A/C Efficiency | 0 | 0 | 1,902 | 1,388 |
| Fiat Chrysler | Primary | Car | Fleet Average | 277 | 270 | 654,845 | -895,074 |
| | | | A/C Leakage | 0 | 0 | 652,065 | 796,491 |
| | | | A/C Efficiency | 0 | 0 | 652,065 | 421,109 |
| | | | Advanced Technology | 0 | 0 | 2,353 | 0 |
| | | | CH ₄ Deficit | 0 | 0 | 132,555 | -5,058 |
| | | Truck | Fleet Average | 359 | 338 | 852,653 | -404,274 |
| | | | A/C Leakage | 0 | 0 | 852,653 | 1,502,157 |
| | | | A/C Efficiency | 0 | 0 | 852,653 | 593,554 |
| | | | CH ₄ Deficit | 0 | 0 | 6,730 | -190 |
| | | | | | | | |
| Ford | Primary | Car | Fleet Average | 247 | 265 | 116,697 | 410,162 |
| | | | A/C Leakage | 0 | 0 | 1,166,975 | 1,237,391 |
| | | | A/C Efficiency | 0 | 0 | 716,500 | 461,932 |
| | | | Advanced Technology | 0 | 0 | 18,551 | 0 |
| | | | CH ₄ Deficit | 0 | 0 | 201,807 | -12,412 |

Table D-1. 2013 Model Year Reported Credits and Deficits

| Manufacturer | Pathway | Fleet | Credit Type | Fleet Average (g/mi) | Fleet Standard (g/mi) | Production Volume | Credits (Mg) |
|-------------------|---------|-------|--------------------------|----------------------|-----------------------|-------------------|--------------|
| | | Truck | N ₂ O Deficit | 0 | 0 | 11,222 | -9,795 |
| | | | Fleet Average | 355 | 355 | 1,234,018 | 0 |
| | | | A/C Leakage | 0 | 0 | 1,234,018 | 2,069,771 |
| | | | A/C Efficiency | 0 | 0 | 1,016,037 | 283,316 |
| | | | Advanced Technology | 0 | 0 | 103 | 0 |
| | | | CH ₄ Deficit | 0 | 0 | 546,764 | -49,342 |
| | | | N ₂ O Deficit | 0 | 0 | 261,005 | -252,940 |
| GM | Primary | Car | Fleet Average | 263 | 263 | 1,432,131 | 0 |
| | | | A/C Leakage | 0 | 0 | 1,431,320 | 1,775,294 |
| | | | A/C Efficiency | 0 | 0 | 1,393,351 | 821,301 |
| | | | Advanced Technology | 0 | 0 | 27,484 | 0 |
| | | | CH ₄ Deficit | 0 | 0 | 376,185 | -27,545 |
| | | | Off-Cycle | 0 | 0 | 45,511 | 13,330 |
| | | Truck | Fleet Average | 373 | 360 | 913,765 | -268,308 |
| | | | A/C Leakage | 0 | 0 | 913,765 | 1,519,501 |
| | | | A/C Efficiency | 0 | 0 | 897,210 | 417,695 |
| | | | CH ₄ Deficit | 0 | 0 | 621,051 | -89,000 |
| | | | Off-Cycle | 0 | 0 | 2,134 | 819 |
| Honda | Primary | Car | Fleet Average | 228 | 256 | 1,021,800 | 5,586,581 |
| | | | A/C Leakage | 0 | 0 | 0 | 264,376 |
| | | | A/C Efficiency | 0 | 0 | 0 | 324,172 |
| | | | Advanced Technology | 0 | 0 | 471 | 0 |
| | | Truck | Fleet Average | 312 | 318 | 472,569 | 640,421 |
| | | | A/C Leakage | 0 | 0 | 0 | 305,581 |
| | | | A/C Efficiency | 0 | 0 | 0 | 181,453 |
| Hyundai | Primary | Car | Fleet Average | 238 | 261 | 1,061,950 | 4,769,294 |
| | | | A/C Leakage | 0 | 0 | 1,061,950 | 445,426 |
| | | | A/C Efficiency | 0 | 0 | 1,061,950 | 571,743 |
| | | Truck | Fleet Average | 317 | 309 | 38,073 | -68,795 |
| | | | A/C Leakage | 0 | 0 | 38,073 | 32,477 |
| | | | A/C Efficiency | 0 | 0 | 38,073 | 32,018 |
| Jaguar Land Rover | Primary | Car | Fleet Average | 319 | 287 | 6,641 | -41,496 |
| | | | A/C Leakage | 0 | 0 | 6,641 | 3,376 |
| | | | A/C Efficiency | 0 | 0 | 6,641 | 2,305 |
| | | Truck | Fleet Average | 312 | 306 | 18,068 | -24,486 |
| | | | A/C Leakage | 0 | 0 | 18,068 | 24,894 |

Table D-1. 2013 Model Year Reported Credits and Deficits

| Manufacturer | Pathway | Fleet | Credit Type | Fleet Average (g/mi) | Fleet Standard (g/mi) | Production Volume | Credits (Mg) |
|--------------|---------|-----------|---------------------|----------------------|-----------------------|-------------------|--------------|
| | TLAAS | Car | A/C Efficiency | 0 | 0 | 18,068 | 17,255 |
| | | | Fleet Average | 358 | 350 | 9,410 | -14,699 |
| | | | A/C Leakage | 0 | 0 | 9,410 | 4,983 |
| | | Truck | A/C Efficiency | 0 | 0 | 9,410 | 4,475 |
| | | | Fleet Average | 477 | 396 | 29,464 | -539,046 |
| | | | A/C Leakage | 0 | 0 | 29,464 | 29,018 |
| | | | A/C Efficiency | 0 | 0 | 29,464 | 30,310 |
| Kia | Primary | Car | Fleet Average | 252 | 258 | 611,414 | 716,323 |
| | | | A/C Leakage | 0 | 0 | 591,064 | 264,796 |
| | | | A/C Efficiency | 0 | 0 | 611,414 | 329,198 |
| | | Truck | Fleet Average | 301 | 303 | 16,980 | 7670 |
| | | | A/C Leakage | 0 | 0 | 16,980 | 21,861 |
| | | | A/C Efficiency | 0 | 0 | 16,980 | 13,040 |
| Lotus | TLAAS | Car | Fleet Average | 334 | 311 | 170 | -763 |
| Mazda | Primary | Car | Fleet Average | 232 | 250 | 164,862 | 579,449 |
| | | Truck | Fleet Average | 296 | 311 | 61,093 | 206,982 |
| McLaren | TLAAS | Car | Fleet Average | 374 | 329 | 412 | -3,620 |
| Mercedes | Primary | Car | Fleet Average | 284 | 262 | 207,951 | -893,318 |
| | | | A/C Leakage | 0 | 0 | 207,956 | 175,477 |
| | | | A/C Efficiency | 0 | 0 | 207,076 | 207,174 |
| | | | Advanced Technology | 0 | 0 | 880 | 0 |
| | | Truck | Fleet Average | 326 | 321 | 60,604 | -68,442 |
| | | | A/C Leakage | 0 | 0 | 66,540 | 102,127 |
| | | | A/C Efficiency | 0 | 0 | 66,540 | 73,347 |
| | | TLAAS Car | Fleet Average | 322 | 344 | 6 | 26 |
| | | | A/C Leakage | 0 | 0 | 1 | 5 |
| | | | A/C Efficiency | 0 | 0 | 1 | 6 |
| | | Truck | Fleet Average | 430 | 424 | 28,437 | -38,538 |
| | | | A/C Leakage | 0 | 0 | 22,501 | 30,070 |
| | | | A/C Efficiency | 0 | 0 | 22,501 | 34,186 |
| Mitsubishi | Primary | Car | Fleet Average | 254 | 249 | 32,654 | -31,881 |
| | | Truck | Fleet Average | 267 | 296 | 13,754 | 90,090 |
| Nissan | Primary | Car | Fleet Average | 232 | 259 | 919,647 | 4,848,497 |
| | | | A/C Leakage | 0 | 0 | 205,189 | 38,523 |
| | | | A/C Efficiency | 0 | 0 | 919,647 | 623,973 |
| | | | Advanced Technology | 0 | 0 | 26,167 | 0 |
| | | Truck | Fleet Average | 332 | 324 | 372,970 | -673,927 |
| | | | A/C Leakage | 0 | 0 | 351,733 | 163,513 |

Table D-1. 2013 Model Year Reported Credits and Deficits

| Manufacturer | Pathway | Fleet | Credit Type | Fleet Average (g/mi) | Fleet Standard (g/mi) | Production Volume | Credits (Mg) |
|--------------|---------|-------|--------------------------|----------------------------|-----------------------------|----------------------|--------------|
| | | | A/C Efficiency | 0 | 0 | 372,681 | 189942 |
| Porsche | TLAAS | Car | Fleet Average | 309 | 314 | 22,021 | 21,500 |
| | | Truck | Fleet Average | 363 | 410 | 19461 | 206,591 |
| Subaru | Primary | Car | Fleet Average | 254 | 251 | 145705 | -85,353 |
| | | Truck | Fleet Average | 270 | 299 | 211326 | 1384203 |
| Suzuki | Primary | Car | Fleet Average | 266 | 243 | 10,427 | -46,828 |
| | | Truck | Fleet Average | 330 | 296 | 1116 | -8,570 |
| Tesla | Primary | Car | Fleet Average | 0 | 296 | 17813 | 1,029,558 |
| | | | A/C Efficiency | 0 | 0 | 17,813 | 19,826 |
| | | | Advanced Technology | 0 | 0 | 17813 | 0 |
| Toyota | Primary | Car | Fleet Average | 224 | 257 | 1347436 | 8,682,490 |
| | | | A/C Leakage | 0 | 0 | 1347436 | 816,463 |
| | | | A/C Efficiency | 0 | 0 | 1347436 | 1,053,911 |
| | | | Advanced Technology | 0 | 0 | 829 | 0 |
| | | Truck | Fleet Average | 339 | 329 | 915658 | -2,068,151 |
| | | | A/C Leakage | 0 | 0 | 902403 | 723,525 |
| | | | A/C Efficiency | 0 | 0 | 915658 | 677,550 |
| Volkswagen | Primary | Car | Fleet Average | 265 | 257 | 559448 | -873,920 |
| | | | A/C Leakage | 0 | 0 | 0 | 290,530 |
| | | | A/C Efficiency | 0 | 0 | 0 | 417,724 |
| | | | CH ₄ Deficit | 0 | 0 | 0 | -57,902 |
| | | | N ₂ O Deficit | 0 | 0 | 0 | -150,195 |
| | | Truck | Fleet Average | 312 | 317 | 68,414 | 77,262 |
| | | | A/C Leakage | 0 | 0 | 0 | 78,562 |
| | | | A/C Efficiency | 0 | 0 | 0 | 80313 |
| | | | CH ₄ Deficit | 0 | 0 | 0 | -434 |
| | | | N ₂ O Deficit | 0 | 0 | 0 | -10889 |
| Volvo | Primary | Car | Fleet Average | 292 | 264 | 42072 | -230024 |
| | | | A/C Leakage | 0 | 0 | 42072 | 51622 |
| | | | A/C Efficiency | 0 | 0 | 42072 | 30611 |
| | | Truck | Fleet Average | 348 | 316 | 31282 | -226096 |
| | | | A/C Leakage | 0 | 0 | 31282 | 51538 |
| | | | A/C Efficiency | 0 | 0 | 31282 | 25343 |